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KOREA

APPRAISAL OF A

SECOND HIGHWAY PROJECT

December 13, 1973

Transportation Division
Asia Projects Department

CURRENCY EQUIVALENTS*

Currency Unit	=	Won (W)
US$1	=	W400
W1	=	US$0.0025
W1 million	=	US$2,500

*The exchange rate is floating, but the rate used in this report is indicated above.

WEIGHTS AND MEASURES
Metric System

Metric		British/US Equivalent
1 meter (m)	=	3.28 feet (ft)
1 kilometer (km)	=	0.62 mile (mi)
1 square kilometer (km^2)	=	0.386 square miles (sq mi)
1 kilogram (kg)	=	2.205 pounds (lbs)
1 metric ton (m ton)	=	(0.98 long ton (lg ton) (1.1 US short ton (sh ton)

ABBREVIATIONS AND ACRONYMS

adt	-	average daily traffic
BPR	-	Bureau of Public Roads
EPB	-	Economic Planning Board
ER	-	Economic Return
GNP	-	Gross National Product
KHC	-	Korea Highway Corporation
KNR	-	Korean National Railroad
MOC	-	Ministry of Construction
MOF	-	Ministry of Finance
MOHA	-	Ministry of Home Affairs
MOT	-	Ministry of Transportation
NHCO	-	National Highway Construction Office
PCB	-	Provincial Construction Bureau
RCB	-	Regional Construction Bureau
TCMC	-	Transport Coordination Ministers' Conference
TPO	-	Transport Planning Office

FISCAL YEAR

January 1 to December 31

KOREA

APPRAISAL OF SECOND HIGHWAY PROJECT

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This report has been prepared by Messrs. A. F. Ballereau (Economist) and P. R. Morris (Engineer).

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SUMMARY AND CONCLUSIONS

i. In line with the long-term high growth rate of the economy, demand for transport in Korea is increasing rapidly. Although the growth rate in GNP has fallen from nearly a 12% average between 1965 and 1971 to about 7% in 1972, as a result of the Government's stabilization program, it is expected to rise to about 8.6% p.a. for the remainder of the Third Development Plan to 1976. Signs of recovery appeared in industrial production and investment toward the end of 1972 and some acceleration of economic expansion has occurred in 1973. Demand for all domestic transport has grown at a rate of nearly 18% between 1965 and 1971. Although its growth rate was temporarily checked in 1972, it is expected to continue to grow at a rate substantially faster than the economy as a whole. Further, highways are taking a steadily increasing proportion, including virtually the entire increase in passenger traffic.

ii. Following the recommendations of the Bank-financed Land Transport Survey in 1967, the Government has devoted an increasing proportion of investment to transport, especially for highways. Between 1965 and 1971 the share of investment in transport has grown from 20% to 24% of capital formation and the proportion invested in highways has increased from 33% to about 46% of all public investment in transport. To improve planning and coordination of transport, including adequate examination of proposals for investment, the Government set up an inter-ministerial Transport Coordination Ministers Conference (TCMC) and a Transport Planning Office (TPO) in the Ministry of Transport (MOT). The staff is being trained and the planning body is expected to become gradually more effective. Its tasks include the review of current Government policies in regard to regulation of transport undertakings, including the somewhat restrictive licensing policies for road transport; the review is being undertaken in collaboration with the Economic Planning Board (EPB) and with other interested ministries.

iii. The present public roads network in Korea is generally fairly adequate in density, but its condition is inadequate to carry the rapidly increasing traffic, particularly on the national highway system. To cope with this situation, the Government's is doubling the highway investment in the third Five-Year Plan 1972-76 with a target, for national highways, of 1,000 km of new construction, including paving, and 4,000 km of improvement and paving of existing highways; and, for provincial roads, of improvement and paving of about 3,500 km. Although these targets may be optimistic, it is expected that the national highway system will be practically completely paved by about 1981.

iv. Of even greater priority than road improvement is the reorganization and improvement of road maintenance. A new maintenance organization, under the Ministry of Construction (MOC), is being set up to maintain national highways and will carry out a program to bring their maintenance up to a satisfactory level. A start has already been made in a pilot province under

the First Highway Project, and the effort will now be extended to the remaining eight provinces. The provincial works organizations, which now maintain the national highways, will then be able to concentrate on the provincial roads.

v. From 1962 onward, the Bank has financed investments in the transport sector with loans, credits and a grant, totalling US$254.7 million; including four railway projects totalling US$120 million; a Bank grant of US$200,000 in 1965 for the Transport Survey and a credit of US$3.5 million in 1968 for studies of highways and transport coordination, refinanced through Loan 769-KO; a First Highway Project for US$54.5 million in 1971; and a port project for US$80 million in 1973.

vi. The Second Highway Project will include construction of 130 km of national highways, paving of a further 634 km of national highways, feasibility studies for future improvement and paving of a further 1,000 km of roads, to be followed by detailed engineering if found justified; and the establishment of a national highway maintenance organization in the MOC, including procurement of highway maintenance and workshop equipment. The project was prepared through studies and engineering carried out under Credit S4-KO and Loan 769-KO.

vii. The construction and paving works, and the procurement of equipment, will all be carried out by contract on the basis of international competitive bidding in accordance with the Bank's Guidelines for Procurement. The domestic contracting industry is well developed and efficient and won all the civil works contracts in the First Highway Project; it is expected to win the bulk of such work in the Second Project. For equipment, the normal preference of 15%, or the amount of the customs duty if lower, will be given to domestic manufacturers. The consulting services to be financed will be carried out by experienced foreign firms, assisted by domestic consultants. The estimated total cost of the project is US$94.0 million. The loan of US$47 million will finance the foreign cost totalling US$38.7 million and about US$8.3 million of local cost.

viii. The construction and paving elements of the project are aimed at lowering vehicle operating costs by improving national highways which have gravel surfaces and are inadequate to cope with increasing traffic. The new improved roads will also serve isolated agricultural and fishing production areas by easing access to consumption markets. The maintenance equipment to be procured under the project will contribute to the setting up of a country wide highway maintenance organization and prevent deterioration of new paved roads and improve the riding conditions of the other national highways. The provision for feasibility and detailed engineering studies will help to prepare a possible third highway project.

ix. The project constitutes a suitable basis for a Bank loan, of US$47 million equivalent, representing about 50% of the total project cost, to the Republic of Korea for a term of 25 years including a seven-year period of grace.

KOREA

SECOND HIGHWAY PROJECT

I. INTRODUCTION

1.01 The Government of the Republic of Korea has asked the Bank to help finance a Second Highway Project consisting of: (a) construction of 130 km of national highways from Saemal to Gangreung and Gangreung to Mukho, including supervision by consultants; (b) paving of 634 km of national highways, Donong-Hoengseong, Jumunjin-Yangyang, Weonju-Maepo, Jupo-Hayeong, Gongju-Gimje, Cheongju-Sangju, Jeomchon-Yeongdeog, Gwangju-Goheung and Yeongsanpo-Ganjin, including supervision by consultants; (c) feasibility studies by consultants for improvement and paving of a further 1,000 km of roads, and detailed engineering of those roads found to be justified; (d) establishment of a national highway maintenance organization, including procurement (to be financed under the loan) of highway maintenance equipment, spare parts, and workshop tools and machinery.

1.02 The Bank Group's previous assistance in financing the transport sector has involved four railway projects: Credits 25-KO for US$14 million in 1962, and 110-KO for US$11 million in 1967; Loan 669-KO/Credit 183-KO for US$55 million in 1970; and Loan 823-KO for US$40 million in 1972. In addition the Bank Group has financed surveys and studies and one highway and one port project: a Bank grant of US$200,000 in 1965 for the Korea Transportation Survey; Credit S4-KO for US$3.5 million in 1968 for studies of highways and transport coordination which was refinanced through the First Highway Project, Loan 769-KO for US$54.5 million in 1971; and a port project, Loan 945-KO for US$80 million in 1973. Performance on these projects has generally been satisfactory. For the First Highway Project, construction is on schedule and within the cost estimates, feasibility studies satisfactorily completed and detailed engineering started, the highway maintenance study carried out and the proposed MOC organization to maintain the national highway system successfully established in a pilot province. The Government has taken measures to improve transport planning and coordination, including training of staff.

1.03 The project has been prepared on the basis of priorities established by the Korea Transportation Survey. This survey recommended increased investment in transport, with greater emphasis on highways. Feasibility and highway maintenance studies, and detailed engineering, were carried out under Credit S4-KO and Loan 769-KO.

1.04 This report is based on information provided by the Government and consultants, and on the findings of the March 1973 appraisal mission, composed of Messrs. P.R. Morris (Engineer) and A.F. Ballereau (Economist). Preparation of the project was delayed by the need for additional information which was brought to the Bank by a Government mission in July 1973, and by consultants in July/August 1973.

II. THE TRANSPORT SECTOR

A. Economic Setting

2.01 Korea has a population of about 32 million which is growing at 2.6% p.a. The Korea economy has been expanding rapidly in recent years, chiefly through a very high growth rate in industrial production and exports. The GNP grew at an average of 7% between 1962-64 and 11.7% between 1965-71. Investment increased from 11% of the GNP in 1960 to 25% in 1971, while the share of exports in the GNP increased from 4% to 25%. Per capita GNP was about US$280 in 1972.

2.02 Since 1970 there has been a slowdown in the rate of expansion of the economy as a result of the Government's stabilization program to reduce inflation through curbing the expansion of domestic credit, and to reduce drastically the large trade deficit. These policies, together with deteriorating world trading conditions, led to a fall in the growth rate of GNP from 16% in 1969 to 10% in 1970, 9% in 1971 and a little over 7% in 1972. The Government's program aims to stabilize the growth at about 8.6% p.a. for the remainder of the Third Development Plan period 1972-76. The expansion of the economy reduced unemployment in urban areas from 7.4% in 1964 to about 4.5% in 1970. Indications are that, with the Government's stabilization program, unemployment has increased to between 6% and 7% in 1972; however, this is expected to drop with the export-led revival in the economy. Signs of recovery have appeared toward the end of 1972 and during 1973 both in industrial production and investment.

B. Transport Modes

General

2.03 Demand for transport has grown even faster than the economy. The share of transport in the GNP has increased from about 3.9% in 1965 to 5.5% in 1971; during that time the value added due to transport has grown at an average of 17.7% p.a. compared with 9.9% p.a. for the GNP. At the same time, the share of investment in transport has grown from 20% to 24% of total capital formation.

2.04 During the Second Five-Year Development Plan 1967-71, domestic passenger traffic (in pass-km) in all modes increased by an average of 11% p.a., while freight traffic (ton-km) increased at about 19% p.a. The entire increase in passenger traffic went to highways. Passenger traffic on highways doubled, but on the railway decreased by about 8%. This resulted in a significant loss of railway revenues since passenger traffic is charged a higher proportion of overhead costs than is freight traffic. Small amounts of passenger traffic are carried by aviation and coastal shipping. Of the increase in freight traffic, about 46% went to coastal shipping, 33% to highways, and 21% to railways; over the period freight traffic

increased 6 times on highways, 4.5 times on coastal shipping and by 27% on railways. In 1971, the share of passenger traffic carried by highways was 71% and by railways 27%; the share of freight traffic was 21% by highways, 50% by railways and 29% by coastal shipping (Table 1).

2.05 To correct transport bottlenecks which occurred during the First Five-Year Plan period, 1962-66, the allocation for investment in transport under the Second Plan, 1967-71, was increased from about 17% to about 27% of the total Government capital expenditure. To keep pace with the demand for transport, the Government is doubling the investment under the Third Plan, 1972-76, to Won 492 billion (US$1,250 million), which is also about 26% of total Government capital expenditure (Table 2). The allocation between the modes is in a similar proportion as in the Second Plan period and is considered reasonable; about 46% for highways, 36% for railways (including the Seoul subway), 16% for ports, maritime transport and storage, and 2% for airports.

Highways

2.06 With the rapid growth of road transport, the present highway system is inadequate. Only 33% of national highways and 9% of other roads are paved. A continued high level of investment will be required in highways. Details are given in Chapter III.

Railways

2.07 The Government's Korean National Railroad (KNR) has 3,085 route-km, all standard gauge, of which 528 km are double track. Electrification of 350 km of industrial lines (carrying chiefly mineral traffic) is in progress and scheduled for completion in 1974. Also in progress and scheduled for completion in 1974 are the electrification of a further 108 km of suburban lines and the construction of a subway for mass transit in the Seoul area.

2.08 Of the rail freight traffic, over 80% consists of bulk commodities: 40% coal, 17% cement, 10% petroleum products, 6% ore, 6% grain and 5% fertilizer. The railway is expected to retain, or increase, its share of this traffic in line with its increased capacity resulting from electrification and improvements in rolling stock. Continued competition from other modes is expected for the remaining 18% of general freight traffic and for passenger traffic; however, the railway is expected to retain a significant amount of such traffic. The railway's finances are expected to be improved through increasing efficiency of operations, partly resulting from Bank financed railway projects and through tariff adjustments.

Ports and Shipping

2.09 Freight traffic through the ports has increased from about 7.5 million tons in 1962 to 51 million tons in 1971. This sharp increase has occurred both in foreign trade and coastal shipping. To meet the resulting port capacity problems, the port facilities are being expanded, chiefly at Busan, Incheon, and Mukho, with the help of loans from the Asian Development Bank and the Bank. In addition, a new port is being constructed

at Pohang for the steel mill. Korea's share of the merchant shipping in foreign trade tonnage has averaged only 20-25% of the total tonnage of foreign trade, slightly decreasing in recent years; efforts are being made to increase this proportion. The expansion in coastal shipping is largely due to the development of industry at Pohang, Ulsan, Masan and other coastal sites.

Aviation

2.10 Domestic passenger traffic carried by air is growing rapidly, but still amounts to only about 1% of the total. Domestic air freight traffic is negligible. Domestic routes are served by the privately-owned Korean Airlines, which also provides a proportion of international flights. There are two international airports: Seoul, which is presently being expanded, and Busan.

C. Transport Planning and Coordination

2.11 To improve transport planning, the Government set up, in 1970, a Transport Planning Office (TPO) in the Ministry of Transportation (MOT). To control the work of this office, the Government also set up a Transport Coordination Ministers' Conference (TCMC), consisting of the eight Ministers most concerned with transport matters, and a Transport Coordination Working Group, a civil service committee with members from the same Ministries. An action program to improve the working of these bodies was included in the Loan Agreement for the Fourth Railway Project (Loan 863-KO); this included undertakings to have the TPO collect data on all transport modes, to have all major investment proposals relating to transport appraised by the TPO before decisions are made, to strengthen the staff of TPO, and to have quarterly reports sent to the Bank. During negotiations for the First Port Project in April 1973, confirmation was obtained that the program would be implemented satisfactorily. However, progress in strengthening staff has been slow. In September 1973, the first two staff members were sent overseas for training, as transport economists. In the meantime the Economic Planning Board (EPB) is reviewing the functions and work program of TPO with a view to implementing the provisions of the agreement for Loan 863-KO. The possible need for revisions in the work program and in the implementation schedule was discussed during negotiations and the Government will submit to the Bank within three months a status report on TPO with a view to discussing appropriate action to be taken by mid 1974.

III. HIGHWAYS

A. The Network

3.01 The public road network totalling about 40,600 km consists of about 8,800 km of national highways, 10,800 km of provincial highways, and

21,000 km of city and county roads (Table 3). The national highways include about 640 km of grade separated toll expressways, of which about 510 km are four-lane divided, and 140 km two-lane. The average road density is 0.4 km of road/km^2 of land area, and 1.2 km of road/1,000 inhabitants. These compare with ratios of 0.1 km of road/km^2 and 1.3 km of road/1,000 inhabitants in Thailand; and 0.2 km of road/km^2 and 1.7 km of road/1,000 inhabitants in the Philippines.

3.02 The road density is generally sufficient to serve transport needs, particularly as around 70% of the total land area is mountainous. However, the condition of most of the road network is inadequate. Only 33% of the national highways are paved, and 2% of the provincial highways (compared with 85% and 35% in Thailand respectively). Further, the unpaved roads are in a poor state. Average driving speeds are usually only in the range of 25-35 kph because the roads are badly aligned, narrow, and have poor drainage and rough gravel surfacing, and a few are unsurfaced. There is thus an urgent need to improve the highway network, particularly: (i) major reconstruction and realignment of a few major trunk routes; (ii) the paving of virtually all remaining national highways, and those provincial highways with high traffic volumes; (iii) improvement of the condition of gravelled and unsurfaced roads, chiefly through improved maintenance; and (iv) instituting an adequate system of maintaining paved highways.

B. Highway Traffic

3.03 Between 1962 and 1972, the motor vehicle fleet grew from about 31,000 to 155,000, an average increase of 18% p.a. (Table 4). However, during the last six years, the growth rate has fluctuated widely. Between 1967 and 1971, it accelerated to an average of 24%, whereas in 1971 it fell to about 12% and in 1972 to 7%. Furthermore, most of the increase in 1972 was in two-wheeled vehicles and, if these were excluded, the growth rate would have been only 3%. The vehicle fleet is still small; it is only 1 vehicle per 206 inhabitants, compared with 1 per 50 inhabitants in Thailand, and 1 per 63 in the Philippines.

3.04 In line with the Government's policy of developing a domestic motor vehicle manufacturing industry, local production increased from about 2,000 in 1962 to 30,000 in 1970 (Table 5). This growth was fostered by restrictive import licensing and high customs duties on foreign assembled vehicles. As a result, nearly all motor vehicles are locally assembled, and with an increasing proportion of locally manufactured parts. The Government hopes also to build up an export trade in vehicles, and an aim is to produce 500,000 vehicles p.a. by 1980. There are three established manufacturing/assembly plants, with joint participation by Korean firms with General Motors, Ford, and Fiat. The combined capacity is about 80,000-90,000 vehicles p.a., with single shift working. Present production is thus only about 30% of capacity. The local content is about 50% for cars and trucks, and about 80% for buses. However, the largest manufacturer is constructing a factory to produce engines and, when these are used, the

local content for cars will be over 60%; in addition, the firm aims to export half of the intended production of 50,000 engines p.a. However, production of vehicles, which had been rising rapidly to 30,000 in 1970, fell to 23,000 in 1971 and less than 19,000 in 1972 with the slowdown in overall economic growth (para 2.02). Some recovery, to about 25,000, is expected in 1973.

3.05 Passenger traffic on highways (pass-km) accounts for about 70% of the total for all modes. The growth rate for highway passenger traffic 1967-71 averaged about 18% p.a. and accounted for the entire increase in passenger traffic for all modes. Highways are expected to continue to take all the increase in inter-city traffic, but the growth of urban passenger traffic is expected to be shared with the railway, particularly the new subway and electrified suburban lines in the Seoul area. Freight traffic on highways (ton-km) represents about 20% of such traffic on all modes. However, the growth of road freight 1967-71 averaged 49% p.a., which was more than double the average (19%) for all freight traffic. The share of freight traffic by road is expected to continue to increase, but at a reducing rate, in the long term. However, since 1971, there has been a sharp fall in the growth of road traffic. This is indicated by a growth in 1972 of only 3% in registered vehicles (para 3.03), and 7% in fuel consumption (gasoline and diesel, Table 6).

3.06 The Government attributes the recent fall in growth of road vehicles and traffic mainly to the economic stabilization policy and the consequent reduction in the growth rate of GNP from 15% in 1969 to 7% in 1972. However, restrictive licensing of commercial vehicles is also believed to have significantly affected growth. Such restrictions include: (a) issuing licenses only to enterprises having a minimum of 20 vehicles in cities or 10 vehicles in country districts; (b) imposing quotas on total numbers of vehicles in each province; (c) limiting the use of vehicles to specific areas or routes; and (d) regulation of rates for freight, as well as passenger traffic. In addition, the cost of vehicles is high as a result of the Government's policy of prohibiting the import of all assembled vehicles (except a small number, in special categories) and requirements that an increasing proportion of domestically manufactured components be used in locally assembled vehicles. The resulting high unit costs, with small production volumes, may have limited potential demand for vehicles.

3.07 The Government recently reviewed its policies concerning the regulation of road transport and in a Policy Statement dated October 5, 1973 has indicated an intention to relax present restrictions. On this basis, and taking account of an expected increase in the growth rate of GNP to 9% p.a. from 1974, the Government has forecast that the annual growth in numbers of registered vehicles will increase from 3% in 1972 to around 18% p.a. from 1974 through 1981. However, even with the expected removal of restrictions, the Government's projections of the growth of the vehicle fleet may be rather optimistic. Slightly lower growth rates have therefore been assumed in the economic analyses of the proposed project. Agreement was reached with the Government during negotiations on policy changes in licensing

and regulation of the use of road vehicles to be introduced not later than June 30, 1975 that would be consistent with the assumed increases in the vehicle fleet.

3.08 Traffic counts on the national highways have been made since 1965 by the Ministry of Construction (MOC), assisted by the provincial authorities. They are carried out twice a year, their reliability has been improved, and use is now made of them in planning of highway improvements. During negotiations it was confirmed that the counting has been extended in 1973 to the provincial highway system, and that the counting, and recording and analysis of traffic data will be continued.

3.09 Current regulations on vehicle weights and dimensions were reviewed by BCEOM as part of the maintenance study carried out under the First Highway Project. This showed that the existing legal limits are reasonable, including a 10-ton single axle load, but that they should be extended to cover semi-trailers and trailer combinations. A 35-ton limit is proposed for all vehicles, and a 16-ton limit for tandem axles. During negotiations, agreement was reached that the Government will amend the regulations, in agreement with the Bank, by December 31, 1975.

C. Highway Administration

3.10 The MOC (see Chart 1) is responsible, through its Bureau of Public Roads (BPR) (see Chart 2) for the planning, design, construction, maintenance and administration of national highways. Local roads, which include provincial, special city (Seoul and Busan), city and county roads, are the responsibility of the local authorities, under the Ministry of Home Affairs (MOHA) (Table 7). However, the MOC has a general responsibility to the Government for the formulation of policy in relation to these local roads.

3.11 The present organizations for planning, designing and constructing highways, with the assistance of consultants and contractors on major works, are satisfactory, the main organizational weakness being in highway maintenance. Historically, responsibility for maintaining all highways rested with the provinces and their local authorities. In January 1971, the MOC was given responsibility for maintaining national highways but, as the MOC did not have a field organization to carry out the work, it continued to be performed by the provinces with grant assistance. This imposes a burden which the provincial authorities are not able to cope with adequately, in addition to maintaining their local roads; over half their resources are presently devoted to the national highways. To improve the situation, the Government is setting up a new MOC field organization.

3.12 The Korea Highway Corporation (KHC) was set up by the Government in February 1969 to construct, operate and maintain toll highways. It is semi-autonomous, with its own Board of Directors, budget and accounts, but is subject to the general direction of the Minister of Construction. The

KHC presently operates 640 km of toll expressways (Seoul-Busan, Seoul-Incheon, Suwon-Weonju-Saemal, and Daejon-Jeonju). It supervised construction of the last two, but so far has not financed any construction, although its Articles of Association permit this.

3.13 The BPR is the headquarters organization within the MOC dealing with the planning, administration, construction and maintenance of national highways. Design and construction of national highways are normally carried out by the five Regional Construction Bureaus (RCBs), which also carry out construction for other Bureaus of the MOC (on ports, water resources, housing, etc.). The design of major highway projects, particularly those financed by international agencies, is carried out with the assistance of consultants, working directly under the BPR; the supervision of their construction is usually carried out by the National Highway Construction Office (NHCO) of the MOC, working under the technical direction of the BPR.

3.14 The provinces through Provincial Construction Bureaus (PCBs) are responsible for the construction, maintenance, and administration of the provincial highway system. The local authorities, that is counties and cities, are responsible for local roads. Two Special Cities, Seoul and Busan (City Construction Sections), are responsible for all roads within their areas.

D. Highway Planning and Financing

3.15 Planning of the national system is the responsibility of the MOC and is carried out by its BPR, which has a Planning Division. The Division carries out traffic surveys and maintains an inventory of national highways. The data for the inventory, hitherto provided by the provinces, have not always been reliable, but this will be remedied when the new MOC field organization has been established over the whole country and takes over data collection. A revised and satisfactory inventory has already been prepared by the new MOC maintenance organization set up in a pilot province. The BPR drafts the Five-Year Development Programs and Annual Budgets for development. These drafts are reviewed by the MOC and revised in consultation with the Economic Planning Board (EPB) and Ministry of Finance (MOF) and finally incorporated into the National Five-Year Economic Development Plans and Annual Budgets. In reviewing the drafts, the aim is to make the programs consistent with the national development and financial targets established by the EPB and the MOF. The BPR is also responsible for giving technical advice on all highway matters to the Government, including the MOHA and the provinces; it reviews proposals originating from these bodies for road improvements and grants for maintenance. Planning of provincial roads is the responsibility of the provinces, and city and county roads are planned by the local authorities concerned.

3.16 The Government plans to spend a total of Won 227 billion (US$568 million) on highways under the Third Five-Year Economic Development Plan (1972-76). Of this, about Won 165 billion is for national highways

and Won 62 billion for provincial and local roads. On national highways, the target is 1,000 km of new construction, or major reconstruction including realignments, and about 4,000 km of paving, including only minor improvements. For provincial roads, the target is to pave and improve a total of about 3,500 km. However, these targets may prove optimistic since unit costs are tending to exceed those used in the plan; also the time required to prepare and execute projects may have been underestimated. Nevertheless, the total allocation of Won 227 billion is likely to be substantially spent, compared with Won 123 billion in the Second Five-Year Development Plan (1967-71) (Table 2), an increase of about 85% at current Won prices. These targets are reasonable in relation to: (a) the present condition of the national and local road networks, on which little improvement has been carried out in the past (see para 3.02); (b) the current level of traffic on national highways, with over 7,000 km already carrying over 500 adt (see para 3.05); and (c) the probable increase in traffic to meet transport demand (para 3.07).

3.17 Over the last five years, expenditures on roads (Table 8) have been lower than revenue from road user charges (Table 9). Budgetary provision for each year is based on the estimated road user charges. These exclude import duties, but include: (a) 75% of the gasoline and diesel tax and 100% of the transport tax levied on public passenger traffic on roads (these items accrue to the Government highway budget); and (b) the vehicle tax, vehicle acquisition tax and registration fees (which accrue to the highway budgets of the provinces, cities and counties). Total taxation on motor vehicles is rather high for a developing country. In particular, the taxes on vehicle acquisition and ownership are high and the Government is considering gradually reducing such taxes but increasing taxes on vehicle use, particularly increasing the tax on diesel fuel which is presently low.

E. Highway Design and Construction

3.18 The responsibilities for highway design and construction of various classes of roads are shown in Table 7. The BPR is responsible for design and supervision of construction of national highways, and for establishing standards for other Government-financed roadworks and for reviewing proposals submitted by provinces and local authorities. In the case of major construction projects, consultants are usually employed for design and to assist with supervision; the supervision of such works is usually delegated to the NHCO, particularly when financed by international agencies. Other works on national highways are designed and supervised by the five RCBs of the MOC, sometimes with the assistance of consultants, and under the general direction of the BPR. The KHC is responsible for design (under the technical direction of the BPR) of toll expressways; it also supervises their construction. The BPR has prepared design standards for national highways (Table 10). They are divided into two parts, one for new construction, or major reconstruction with substantial realignment, while the alternative standards have been devised for paving of existing

highways with minimum realignment and improvement. Both sets of standards are reasonable for their purposes.

3.19 Virtually all construction is carried out by contracts which are awarded after competitive bidding. This has provided a large and increasing volume of work and forms the basis for the Government's policy of promoting the growth of the domestic contracting industry. Further assistance in the initial stages was provided through Government loans on favorable terms to contracting firms for the purchase of equipment. There is now a well established and efficient domestic contracting industry, with about 750 firms, including several large ones which undertake works overseas as well as in Korea. The largest 10 firms were engaged on contracts in 1971 ranging from US$4 million to US$30 million. Foreign contractors have had little success, because of price competition, in obtaining civil engineering work in Korea, though a number of firms have expressed interest in bidding. Some minor construction is undertaken by force account by the RCBs, PCBs, and City and County Construction Sections. The army is responsible for roadworks in the northern border area.

3.20 The choice of construction methods is left to the contractors, subject to complying with performance specifications. The Government does not impose any conditions or incentives on the use of equipment or labor. The smaller local authorities, particularly counties, tend to use a greater proportion of labor on their force account works because they have only a very limited amount of equipment and much of the work is of a nature which can be fairly easily adapted to hand methods. For example, many small access roads are being constructed and improved through local community effort.

F. Highway Maintenance

3.21 Although there has been some improvement in recent years, the maintenance of highways is still unsatisfactory. Financial allocations by the Government for maintaining national highways have barely increased in real terms and are insufficient. The maintenance agencies (Table 7) have inadequate staff, equipment and finances to maintain the national, provincial and local road systems. Except for the expressways, the existing paved roads are not being promptly repaired, and their surfaces renewed periodically on a systematic basis as required to prevent their further deterioration and eventual collapse. The majority of the roads, which are gravel-surfaced, are extremely rough, often corrugated, incorrectly shaped to provide adequate drainage, and much erosion from flooding has not been repaired. Further, many sections of gravel-surfaced national roads are carrying traffic volumes beyond their capacity. The road system, including the national highways, is therefore in poor condition and road transport costs are unnecessarily high. The Government is aware that an extensive paving program is required and has had consultants BCEOM (France) assist in preparing one, as part of the Highway Maintenance Study which the firm has been carrying out under the First Highway Project, Loan 769-KO. The present project was formulated to include a large paving item.

3.22 To provide a satisfactory system of road maintenance, the Government is setting up a new field organization, within the MOC, to maintain national highways. The provincial and local authorities will then be relieved of all work on national highways, which presently absorbs over 60% of their entire financial and other resources devoted to roads; they will thus have the capacity to raise the maintenance of provincial and local roads to a satisfactory level. To this end, the MOC has already established its new maintenance organization in a pilot province, with equipment financed under the First Highway Project, Loan 769-KO. Construction of maintenance facilities for the two field sections (districts) in this province was completed in August 1972 and the sections began to operate from September 1, 1972, initially with rented equipment and working in collaboration with the provincial authority. All the equipment has now arrived, and the field sections are fully operational. First indications of their performance are encouraging. Technical assistance has been provided by BCEOM as part of the Highway Maintenance Study.

3.23 The report by BCEOM on the Highway Maintenance Study includes proposals for extending the MOC field organization to the remaining eight provinces. These proposals, which have been accepted by the Government, entail setting up a further 17 field sections (districts), making a total of 19, to cover the entire national highway network. Each will have a depot, with an office and a workshop, and will be provided with highway maintenance equipment appropriate to the roads for which it is responsible. Arrangements are being made to obtain the staff required, partly by transfers from other parts of the MOC, and partly by recruitment, and for their training through courses to be conducted by the Ministry's Training Center, and by attachment, in rotation, to the two field sections operating in the pilot province. BCEOM will continue to provide technical assistance, as an extension of the maintenance study, for setting up the nation-wide MOC highway maintenance field organization. A schedule for completing the installation of the MOC's field organization was prepared by the consultants and discussed with the MOC by the appraisal mission. During negotiations, at the request of the Government a modified schedule was agreed to allow an additional year to complete the installation (Table 11).

3.24 The BCEOM Highway Maintenance Study report included a plan for setting up the MOC's field organization, including the depots, offices, workshops and other installations, and lists of highway maintenance equipment, and workshop equipment needed, with cost estimates (Table 12). Further, the Study included an assessment of the work to be carried out, with cost estimates, for a program of highway maintenance for the years 1975 through 1981, and estimates were prepared of the capital costs and the recurrent costs to carry it out (Table 13). During loan negotiations, assurances were obtained from the Government that it will: (a) set up the MOC's nation-wide field organization for maintaining highways in accordance with the agreed implementation schedule, including providing all the staff, installations, equipment, and capital financing required; (b) carry out the program of highway maintenance of the national highway system recommended by BCEOM, including providing the recurrent financing required; (c) thereafter cause the national highway system to be adequately maintained in accordance with sound engineering

and highway practices, and provide promptly as needed the funds, facilities, services and other resources required for such maintenance, including repairing and renewing, as necessary, the highway maintenance and workshop equipment.

IV. THE PROJECT

A. Description

4.01 The Project consists of:

(a) construction, chiefly on new alignments, including paving, of about 130 km of two national highways, and supervision by consultants;

(b) paving and improvement, chiefly on present alignments, of nine national highways totalling about 634 km, and supervision by consultants;

(c) feasibility studies by consultants of about 1,000 km of national and provincial roads, to be followed by detailed engineering if found justified; and

(d) procurement of highway maintenance and workshop equipment for the extension of a new national highway maintenance organization from a pilot province to the remainder of the country.

(a) Construction

4.02 Two sections of national highways, described in Annex A, will be constructed, chiefly on new alignments, with two-lane pavements: (a) Saemal-Gangreung (97 km); and (b) Gangreung-Mukho (33 km). Feasibility studies of these two highways were carried out in 1969-71 by the consulting firms, Ammann and Whitney/Trans Asia (US) and Ingeroute (France), under Credit S4-KO. Ingeroute carried out the detailed engineering in 1972-73, financed under the First Highway Project. Both highway sections pass through difficult mountainous terrain and have poor alignments, with steep gradients, so that travel speed averages only 25-30 km/h even in dry weather. The new alignments are designed for a normal minimum speed of 50 km/h in the mountainous areas, but will have a few substandard sections in particularly difficult parts of the terrain. The hilly sections will have a design speed of 70 km/h and rolling sections 100 km/h (Table 10).

(b) Paving

4.03 Nine sections of national highways described in Annex B will be paved to two-lane width, mainly on their present alignments, but with improvement of curves and widening of the roadway and shoulders. The road level will be raised and ditches constructed to improve drainage, and existing bridges widened or reconstructed, or new ones constructed, where necessary: (a) Donong-Hoengseong (71 km); (b) Jumunjin-Yangyang (30 km); (c) Weonju-Maepo (52 km); (d) Jupo-Hayeong (26 km); (e) Gongju-Gimje (77 km); (f) Cheongju-Sangju (102 km); (g) Jeomchon-Yeongdeog (132 km); (h) Gwangju-Goheung (102 km); and (i) Yeongsanpo-Gangjin (42 km).

4.04 Four of the roads to be paved were selected on the basis of feasibility studies carried out under Credit S4-KO and under the First Highway Project. The remaining highways were selected on the basis of a paving program (which forms part of the Third Five-Year Plan 1972-76) prepared by the Government with the assistance of the consulting firm BCEOM (France) provided in the course of their study of Highway Maintenance, also financed under the First Highway Project. BCEOM carried out the economic part of the studies and also directed the engineering of the roads undertaken by three Korean consultants: (a) Korea Engineering Consultants Corporation; (b) Yooshin Engineering Corporation; and (c) Dongil Consulting Engineering Company. The detailed engineering of all nine roads was carried out under the direction of BCEOM, with the assistance of the three Korean consultants.

(c) Supervision of Construction and Paving

4.05 The Government intends to have supervision of construction of the Saemal-Gangreung and Gangreung-Mukho Highways (para 4.02) carried out jointly by the Korea Highway Corporation (KHC) and Ingeroute, the design consultants. The Government intends to have supervision of paving of the nine highways (para 4.03) carried out jointly by the National Highway Construction Office (NHCO) of the MOC and BCEOM, the design consultants. Both KHC (para 3.12) and NHCO (para 3.13) have sufficient staff to provide the field supervisory teams. However, their performance so far indicates that both organizations lack technical competence, experience and independence, to supervise the work satisfactorily unaided. The Government has drafted, and agreed with the Bank, terms of references for employing the design consultants for supervision. The Government confirmed during negotiations that the consultants will be employed on conditions satisfactory to the Bank, and that no contract will be awarded for construction or paving until the supervision consultants have been appointed.

(d) Feasibility Studies and Detailed Engineering

4.06 The project includes feasibility studies by consultants, to be followed by detailed engineering if found justified, of about 1,000 km of roads. The roads have yet to be selected, but they are expected to be mainly national highways scheduled for construction or paving to be

commenced late in the Five-Year Development Plan 1972-76; however, some high priority provincial roads may be included. Agreement was reached during loan negotiations that the selection of highways for the feasibility studies and of sections for subsequent detailed engineering will be made in agreement with the Bank, and that the Government will not carry out any works other than maintenance or minor improvements on the highways without first consulting the Bank.

(e) Procurement of Highway Maintenance Equipment

4.07 The Project includes the procurement of highway maintenance and workshop equipment (Table 12) to assist the Government in extending the MOC field maintenance organization from the pilot province to the remaining eight provinces (paras 3.23 and 3.24).

B. Cost Estimates and Foreign Exchange Component

4.08 The cost of the project, including contingencies, is estimated at US$94.0 million. The foreign exchange component is estimated at US$38.7 million, or 41%. Estimated costs are shown in Table 14, and are summarized on the next page. The estimated average costs per km (including contingency allowances) are: (a) for construction $270,000; (b) for paving $71,000; (c) for supervision by consultants $5,200; and (d) for feasibility studies and detailed engineering by consultants, for improvement and paving $1,500.

Project Element	Won (million) Local	Foreign	Total	US$ (million) Local	Foreign	Total	% Foreign Exchange Component
I. Construction of two Highways	7,590	4,090	11,680	19.0	10.2	29.2	35
II. Paving of nine Highways	9,620	5,180	14,800	24.0	13.0	37.0	35
Subtotal I & II	17,210	9,270	26,480	43.0	23.2	66.2	35
III. Consulting Services:							
(a) Supervision I & II	720	720	1,440	1.8	1.8	3.6	50
(b) Feasibility Studies & Detailed Engineering	280	280	560	0.7	0.7	1.4	50
Subtotal III	1,000	1,000	2,000	2.5	2.5	5.0	50
IV. Maintenance Equipment	/1	3,000	3,000	/1	7.5	7.5	100
V. Contingency Allowances:							
(a) Physical /2	1,820	1,330	3,150	4.6	3.3	7.9	
(b) Price /3	2,060	920	2,980	5.2	2.2	7.4	
Subtotal V	3,880	2,250	6,130	9.8	5.5	15.3	
TOTAL PROJECT COST	22,090	15,520	37,610	55.3	38.7	94.0	41

/1 Small amount for local handling, assembly and transport of imported equipment; also possibly a small amount for local manufacture/assembly, if domestic suppliers submit successful bids for part of the equipment. The total local cost is unlikely to exceed about 15% of the foreign cost of equipment and will probably be under 10%.

/2 10% on all items.

/3 12% on local and 10% on foreign cost of construction and paving.

4.09 Cost estimates for construction of the Saemul-Gangreung and Gangreung-Mukho highways have been prepared by Ingeroute on the basis of detailed bills of quantities prepared after completing detailed engineering, and of unit prices for similar work obtained from competitive bidding in late 1971 on the First Highway Project, adjusted to cover increases in costs to late 1973, when bids are scheduled to be received. The cost estimates for paving the nine highways included in the project have been prepared by BCEOM on the basis of quantities calculated after completing detailed engineering, and unit prices obtained from international competitive bidding on the First Highway Project, adjusted for price increases estimated to early 1974, when bids are expected to be received; also taking into account more recent prices obtained by the Government through competitive bidding on similar work.

4.10 The cost estimates for consulting services for supervision of construction and paving and for feasibility studies and detailed engineering of further highways are based on previous contracts with consultants for similar work. The foreign exchange costs are relatively low because of the large proportion of Koreans employed on the work. The cost estimates for procurement of highway maintenance and workshop equipment are based on the Maintenance Study carried out by BCEOM under the First Highway Project. The prices have been adjusted to the levels expected in late 1974, when contracts are to be awarded.

4.11 Contingency allowances of about 22% for construction and 10% for consulting services and procurement of maintenance equipment are considered reasonable. The contingency for construction and paving allows 10% for possible increases in quantities of work, and 12% for increases in local prices (about 8% annually) and 10% in foreign prices (about 7.5% annually) from the expected time of receiving bids to the completion of construction and paving. The 10% physical contingency allowance for consulting services is for possible increases in the man-months required. The 10% physical contingency allowance for maintenance equipment allows for additional items of equipment and spare parts which may be found necessary; allowance for increases in prices are not required, since the bids will be on a fixed price basis. The cost estimates and contingency allowances were reviewed and agreed with the Government during loan negotiations and are considered reasonable.

4.12 The consultants Ingeroute and BCEOM estimate that the foreign exchange component of the higway construction and paving works is between 43% and 46% if carried out by foreign contractors; between 31% and 33% if carried out by local contractors. Under the First Highway Project, three foreign firms were prequalified, but all contracts were won by local firms. For this project also, three foreign firms have been prequalified, as well as 25 local firms. It is likely that most of the contracts will be won by local contractors; assuming this proportion to be 80%, the effective foreign exchange component would be about 35%, and the foreign exchange component of the project has been calculated on this basis. The foreign exchange component of consulting services is estimated at 50% for supervision, studies and detailed engineering. The foreign exchange component of highway maintenance and workshop equipment has been assessed at 100% of c.i.f. cost of

imported equipment, though a small proportion of the equipment may be manufactured or assembled locally.

C. Execution

4.13 The MOC will be responsible for carrying out the project, through its BPR. Consultants will assist in supervising the construction and paving of highways, and in carrying out feasibility studies and detailed engineering. Consultants, financed under the First Highway Project, will continue to provide technical assistance in setting up and initially operating the MOC Organization for maintaining national highways, including the procurement of highway maintenance equipment. During negotiations, agreement was reached with the Government that it will employ consultants, acceptable to the Bank, for these purposes on terms and conditions satisfactory to the Bank; also on the terms of the proposed contract between MOC and KHC for supervision of construction, to ensure that they are compatible with preserving the responsibilities of the consultants.

4.14 Highway construction and paving will be carried out through contracts awarded on the basis of international competitive bidding by prequalified firms, in accordance with the Bank Groups "Guidelines for Procurement". Highway maintenance and workshop equipment will be procured through contracts awarded after international competitive bidding, also in accordance with the "Guidelines for Procurement"; foreign bids will be evaluated on the c.i.f. (port of entry) cost, and local bids on the ex-factory cost allowing a margin of preference to domestic manufacturers equal to 15% of the c.i.f. cost or the customs duty for each item, whichever is lower. During negotiations, assurances were obtained that the Government will follow these procedures for procurement; also that the Government will not place restrictions on the importing of equipment, either by contractors for carrying out the civil works or on procurement of the highway maintenance and workshop equipment.

4.15 Contractors are left to choose their own construction methods, including the optimum use of equipment and labor, subject to the work complying with the specifications. The construction and paving contracts are expected to be awarded during the first quarter of 1974 and to take about 2 years. The feasibility studies are expected to be started in early 1974 and detailed engineering carried out in 1975. Bids for highway maintenance and workshop equipment will be invited in mid-1974, and deliveries completed by end of 1975. The works are expected to be completed in the second half of 1976 and, allowing for settlement of final payments, and completing disbursements, the closing date for the loan will be December 31, 1977. During negotiations, agreement was reached with the Government on the timing of project execution and on arrangements for reporting progress.

4.16 The ecological effects of the highway construction and paving works were not specifically included in the studies carried out, but no significant

problems are expected. Soils are not generally of the kinds especially subject to erosion, and adequate drainage and grassing of earthwork slopes will be provided. The paving of the highways will eliminate present serious discomfort, particularly in villages and towns, caused by dust in dry weather and mud during rainy weather. Acquisition of the right-of-way will cause minimal disturbance; the new construction passes mainly through thinly populated hilly terrain, and the alignments have been chosen to avoid, as far as practicable, buildings and rice paddies or other intensively cultivated land, while the alignment of the highways to be paved largely follows the existing roads, thus minimizing the additional right-of-way. Confirmation was obtained during negotiations that acquisition of the right-of-way on each highway section will be completed before a contract for construction or paving is awarded.

D. Financing

4.17 The proposed loan of US$47 million will finance about 50% of the estimated total project cost of US$94.0 million (Table 14). The remaining cost will be financed by the Government, which is expected to provide the funds promptly, as it has under the First Highway Project. The Government confirmed, during negotiations, that it will make timely provision for funds to carry out the project.

E. Disbursements

4.18 Disbursements from the Loan Account will be made on the basis of: (i) 45% of the total cost of construction and paving; (ii) 100% of the foreign exchange cost of the consulting services; (iii) 100% of the c.i.f. cost of imported highway maintenance and workshop equipment, or of the ex-factory price, excluding identifiable taxes and duties, of locally manufactured equipment, or 75% of the total cost of imported and locally purchased equipment. On this basis, and on the schedule for executing the project (para 4.15), a Schedule of Estimated Disbursements (Table 15) has been prepared.

V. ECONOMIC EVALUATION

A. General

5.01 The Second Highway Project will continue the Bank assistance to Korea in its efforts to improve and modernize the road transport system. The benefits accruing from the project are essentially a reduction of unnecessary high costs of moving goods and people and an easier access to some isolated areas with high economic development potential. The project

will also help to cope with the present and planned growth of the transport demand of this fast growing, export-oriented economy, and particularly with the demand for road transport which registered in recent years the highest increase of all modes for freight and passengers, in spite of a severe but apparently temporary slowdown since 1971 (paras 3.03 to 3.07).

5.02 The highway construction (130 km) and paving (634 km) elements of the project will contribute to the achievement of the Government's targets for the construction of 1,000 km national highways and the paving of another 4,000 km during the Third Five-Year Development Plan (1972-76). In addition, the project will support the extension of the new highway maintenance organization to the entire national road network. The objectives are to prevent the deterioration of newly improved highways and to upgrade the riding conditions of the others, resulting in savings in vehicle operating costs. The project includes also a provision for the financing of further feasibility and detailed engineering studies for the paving of about 1,000 km of road in preparation for a possible third project.

5.03 This project supports the Government's present strategy in the 1972-76 Plan of giving priority to the paving of existing gravel roads, which still account for two-thirds of the national network, rather than concentrating chiefly on the construction of new high-standard highways as in the past. Feasibility studies of roads have shown that for most sections, at the present time, the optimum first stage of improvement is to pave the road largely on the present alignment, with only minimum improvements of sharp curves, etc., and widening and improvements of drainage. The lower cost of such work permits the paving of two to three times the length of road which could be newly constructed. However, there are some sections where factors, including the traffic volumes, inadequacy of present alignments, possibility of substantial shortening of the routes, etc., justify immediate construction on new alignments. The present approach of minimizing and phasing investments, increases the feasibility of road projects and enables the highway system to meet a much larger total transport demand at lower cost; it follows the recommendations of the consultants and of the Bank. It contrasts with past policy during the Second Plan, 1967-71, when priorities were decided on non-economic considerations, particularly in constructing the Seoul-Busan to 4-lane grade-separated standards which were unnecessarily high for many sections and which absorbed a large proportion of the total finances devoted to highways. The new emphasis on highway maintenance also represents a major advance in policy, since the present organization is inefficient and resources devoted to maintenance inadequate, resulting in the present poor state of the road system.

B. Highway Construction

5.04 The construction of the Saemal-Gangreung (97 km) and Gangreung-Mukho (33 km) highways will complete the cross-country axis, linking the Seoul area to the north-east province. The coastal region is an enclave oriented to the sea and is isolated from the rest of the country by a

prominent north-south mountain range. Although Seoul is only 230 km away, it takes more than 8 hours by road or 12 hours by train to reach Gangreung, the regional capital (80,000 inh.). This isolation has been an obstacle to the development of local resources which include fisheries, forestry, mineral deposits including important coal mines (Mukho), cement plants (Samcheok) and a very promising tourism industry based mainly on sea-side resorts, but also on hiking and skiing in the mountains. The hinterland has a low density of population but the coastal area from Sokcho to Samcheok has an important urban population of over 350,000 in a number of cities and villages including Yangyang, Jumunjin and Mukho. However, the growth of the population of the province from 1966 to 1971 was only 0.5% per year compared to an average of 1.9% for the whole country and 6.5% for the Seoul metropolitan area. The province contributed significantly to the migration to big cities since it is unable, because of its isolation, to provide sufficient employment locally in spite of its important resources.

5.05 The economic analysis was carried out by Ingeroute (France), in a feasibility study completed in 1971, financed under Credit S4-KO, and was up-dated in the detailed engineering study. Present traffic volumes of the two roads for construction are described in Annex A. Ingeroute's estimated traffic assignments, growths and forecast volumes (Tables 16 and 17) are based on a detailed traffic origin and destination survey conducted in 1969 and on further counts performed in July and August 1972. The assignments take into account the traffic expected to divert to the new road from existing roads and from other transport modes. The traffic forecasts include estimated normal and generated growth.

5.06 About 80% of the traffic on the existing gravel roads would divert to the new facilities. In addition, traffic diversions to the Saemal-Gangreung Highway are expected from the northern highway between Hongcheon and Sokcho, from the railroad between Seoul and the east coast and from the airlines between Seoul and Samcheok, Gangreung and Sokcho. Diversion from the two latter modes would occur also to the Gangreung-Mukho Highway. However, the diverted traffic from the railway and airlines would each account for less than 5% of the expected traffic volume of the new roads, and consist mainly of passenger traffic. The railway line between Seoul and Gangreung has a competitive disadvantage, as mountainous ranges force the line on a long detour to the south via Yeongju, adding up to 4 hours in travel time compared to the existing highway. Under the Fourth Railway Project a small additional railway link in Jangseong will shorten the line by 50 km and the line is being electrified between Seoul and a junction just south of Mukho. Nevertheless, the competitive position of the railway will worsen when the new highway Saemal-Gangreung is completed, as road travel time will be reduced by half. The consultants have estimated that about 35% of railroad passengers between Seoul and Gangreung will then divert to the new road, and 80% of those on the section between Gangreung and Mukho. The expected drop of passenger traffic and the absence of freight handled on this latter marginal line section of 30 km, which is not being electrified, should lead the KNR to consider its closure unless some coal deposits in the area prove to be exploitable economically. The KNR is following a policy of closing marginal lines.

5.07 The proper function of the Seoul-Mukho line is to handle heavy bulk loads, such as coal, cement and timber. The increase in capacity of this line, being financed with Bank assistance, will reduce the present transport shortage which required priority to be given in winter to transporting coal, forcing cement and other heavy loads to rely on road transport, in addition to general freight. It is therefore expected in the near future, that a better complementary use will be achieved of transport modes in the eastern region; the railway line would specialize in bulk commodities and leave the roads to carry passenger traffic and non-bulk cargoes such as fish products requiring quick delivery and special care including door to door service. Airline routes are likely to suffer more seriously from road competition as it is expected that 60% of the air passengers on Seoul-Gangreung and 30% of those on Seoul-Sokcho, and on Seoul-Samcheok would divert to the new highways. The monopoly of air routes for fast transport in the area is therefore expected to be strongly challenged by the new roads providing much lower transport costs, and narrowing the air advantage for travel time.

5.08 The normal traffic growth rates were estimated on projections of the local population, vehicle fleet, and per capita income and adjusted to take into account the recent slow-down in the rate of increase of registered vehicles and of vehicle manufacture, and of gasoline consumption (Tables 4, 5 and 6) but assuming that vehicle licensing regulations will be relaxed (para 3.07). The expected rates of generated traffic induced during the first two years after opening of the new facilities are very high (45 to 25% p.a.) and are based on the large traffic increase previously observed after the opening of the first section of this highway, Suwon-Saemal, at the end of 1971. However, they are deemed reasonable in view of the important time and distance reductions of the project roads (22 km for Saemal-Gangreung and 8 km for Gangreung-Mukho). The generated traffic rates take into account the transportation share of development benefits resulting from the improved connection between the northeastern province and the Seoul area, in particular the promotion of the fishing and tourism industries, which were not assessed separately.

5.09 The average vehicle operating costs for each road are given in Table 18 and were assessed for typical vehicles, taking into account road standards and traffic density. The savings in passengers time was quantified separately with hourly time values of 75 Won per private car passenger and 30 Won per bus passenger. Benefits of the proposed construction of the Saemal-Gangreung and Gangreung-Mukho Highways were determined as the difference in road user and maintenance costs with and without the project and are shown in detail in Table 20. Economic returns (ERs) for each road, calculated over an assumed 20 years service-life of the investments, are 28% and 25% respectively. The sensitivity of the ERs was tested by varying construction cost by $\pm$15% and benefits by $\pm$25%. Under the pessimistic assumption of an increase in construction cost concurrent with a decrease in benefits, the ERs are 21% and 15% respectively (Table 23). Exclusion of passenger time saving would reduce the above returns by about two percentage points. Thus, the highway construction element of the project is amply justified. The traffic forecasts and economic evaluation have

been based on the assumption that no tolls will be levied, and the Government confirmed that tolls will not be levied on any section of the highways to be constructed or paved without the concurrence of the Bank.

C. Highway Paving

5.10 The nine roads to be paved under the project are located in different provinces, five are in the eastern central part of the country, all oriented east-west, except the Jumunjin-Yangyang road which runs south-north, as do the three other roads located in the south-western region. All nine roads are national highways but serve largely regional interests as they link towns and villages to major arteries. Their improvement will assist the development of densely populated, but presently rather isolated, regions. The areas served depend essentially on agriculture, particularly on rice, barley, cabbage and other vegetables, plus, in the Andong area, fruit and tobacco. The present gravel roads were selected among a priority list established from traffic counts by the Ministry of Construction. They are typical for a paving program with traffic volumes ranging between 100 and 800 adt, and require little or no realignment within the service-life of the roads, to satisfy their multi-purpose transport function. In addition, but not part of the project, the Government intends to pave by December 31, 1975, the section Hoengseong-Saemal (14 km) which links the two project highways Donong-Hoengseong and Saemal-Gangreung. This was confirmed during negotiations.

5.11 The economic evaluation of the paving program was carried out by BCEOM (France); traffic surveys were sub-contracted to three Korean firms (para 4.04). Traffic volumes and estimated growth are shown in Tables 16 and 17, and details of traffic characteristics for each road are given in Annex B. Traffic forecasts are based on past and expected growth of the GNP as defined in the Third Five-Year Economic Development Plan, on forecasts of population increase and on past traffic growth for each studied road, but assuming the relaxation of vehicle licensing restrictions (para 3.07). No diversion of traffic from other roads is assumed since the Development Plan objectives are to pave the larger part of the national highway network by 1976. The high growth rates selected up to 1976 for normal traffic include implicitly the generated traffic induced by the reduction of vehicle operating costs. Only the Weonju-Maepo road and part of the Gongju-Gimje road offer competition with the railroad, but even on these sections possible diversions of rail traffic are deemed negligible.

5.12 The assessed benefits result from savings in vehicle operating costs due to the improved conditions on the newly paved highways compared with the existing rough graveled roads, and from reduction in road maintenance costs. The average vehicle operating costs, with and without passenger time savings, are shown in Table 18 and take into account highway standards, terrain condition and vehicle speed. The transport costs per km will be reduced by about 15% for private cars and 30% for taxis, buses and trucks.

As the roads will follow closely their existing alignments, negligible benefit is obtained from distance reduction, but savings occur from reduced travel time due to increased speed of vehicles. Hourly time values of passengers are identical with those used in analysis of the highways to be constructed (para 5.09). In addition to reduced travel costs benefiting the road users, part of which may be passed on to urban consumers and to farmers in the areas served, the new pavements would bring other non-quantified benefits such as quicker and improved services, reduction of the nuisance and accidents caused by heavy dust resulting from increasing traffic on the existing gravel surfaces.

5.13 The estimated streams of costs and benefits over the assumed 16 years service-life of the investments and economic returns (ERs) for each road are shown in detail in Table 21. ERs range between 23% and 49% with passenger time savings included, and 22% and 45% without. The sensitivity of the ERs was tested under the same assumption as for the highway construction (para 5.09) and the pessimistic assumption gives ERs ranging between 16% and 35% (Table 23). These returns are satisfactory to justify the paving element of the project.

D. Highway Maintenance Program

5.14 The recommended program for improving the standard of maintenance covers about 8,150 km of graveled and paved national highways (paras 3.21 to 3.24). It includes the investments in equipment, workshops and depots (Table 12) and the increase in maintenance budgets (Table 13) which are expected to yield considerable savings in vehicle operating costs. These savings would accrue gradually while the program is being implemented by: (i) preventing further increase in vehicle operating costs; and (ii) gradually improving road conditions and reducing vehicle operating costs. Only the latter element was included in the quantification of the program's benefits in the economic analysis carried out also by BCEOM.

5.15 The vehicle operating cost savings expected per vehicle in the fourth year of operation (when the program is fully effective) and thereafter are shown in Table 19; they range from 2% to 6% on paved roads and from 5% to 15% on gravel roads. These unit savings correspond to Bank experience elsewhere for similar projects. The average traffic growth rate assumed is 10% p.a. Based on most probable estimates of maintenance costs, including a sizeable increase in recurrent costs, and benefits from vehicle operating cost savings on gravel and paved roads, the maintenance program over the seven years service-life assumed, would yield an economic return of 53%. The detailed costs and benefits streams are shown in Table 22. A sensitivity test of a pessimistic situation with a cost increase of 10% and a reduction in benefits of 20% would reduce the ER to 21%. Alternatively, an optimistic assumption with 10% lower cost and 20% higher benefits would increase the ER to 85% (Table 23).

5.16 Even on very conservative assumptions, the maintenance program would yield satisfactory returns; this indicates that additional road maintenance, at a low cost per km, is a highly rewarding investment deserving highest priority in the highway development program. Furthermore, without maintenance program, considerable resources would be required in a few years to rehabilitate the network. The saving of these resources was not taken into account in the benefits of the proposed program but would make the maintenance program even more attractive.

VI. AGREEMENTS REACHED AND RECOMMENDATION

6.01 During loan negotiations the Government gave assurances on a number of points, the more important ones being that the Government will: (a) amend, by June 30, 1975, the regulations governing licensing of motor vehicles to eliminate requirements as to the minimum numbers of taxis, trucks and buses to be owned or operated by a firm or individual to qualify for a commercial license, and to remove restrictions (other than normal regulations relating to safety and traffic control) on the use of the national highway network by trucks and buses (para 3.07); (b) set up by January 1, 1976 the MOC field organization for maintaining the national highway system in the remaining eight provinces (para 3.23) and carry out the agreed program of highway maintenance for the period 1975-81 (para 3.24); and (c) not levy tolls on the highways to be constructed or paved as part of the project without the concurrence of the Bank (para 5.09).

6.02 The project is suitable for a Bank loan of US$47 million (representing about 50% of total cost) for a period of 25 years, including a 7 year period of grace.

December 13, 1973

KOREA

SECOND HIGHWAY PROJECT

Description of Project Highways to be Constructed

A. Saemal-Gangreung (97 km)

1. Between Seoul and Suwon there is a four-lane divided toll highway 29 km), completed in 1969, and between Suwon and Saemal, (the start of the project road), a two-lane paved toll highway (104 km), completed in late 1971. From Saemal to Gangreung, the existing highway crosses a mountainous area. The alignment follows the river valleys and is poor, especially on two very mountainous sections where gradients reach 11%, with many very sharp curves. The road is surfaced with river gravel, containing many large stones, which corrugates and ruts badly. Average travel speed in dry weather is about 30 km/h, but is even less in wet weather, or when the road is icy. Drainage is poor.

2. The new two-lane highway will be constructed on a new alignment to design standards for new construction (Table 10, Part A), roughly parallel to the existing road, but with substantial deviations from it, particularly through the very mountainous areas. It will be 22 km shorter than the present road. The new highway will have a 7.20 m wide asphaltic concrete pavement and 1.75 m wide shoulders, surfaced with gravel. The terrain is about 20% rolling, 45% hilly and 35% mountainous. In the mountainous areas, particularly to reduce the maximum gradient to 8%, two tunnels will be constructed, 150 m and 570 m long. The work will include 23 new bridges, the longest being 276 m.

3. Present traffic varies between 370 and 450 average daily traffic (adt) on most of the distance except for the last 10 km near Gangreung, where traffic increases to 880 (adt). The traffic composition is about 45 to 55% for passenger cars, 15% for buses and 30 to 40% for trucks. Some military vehicles, less than 3%, use the road mainly near the Weonju and Gangreung areas. The average annual growth rate of the traffic from 1969 to 1972 was 44% for cars, 11% for buses and 27% for trucks. These unusually high growth rates, particularly for cars, may be explained by the opening in 1971 of the new two lane expressway linking Saemal to Suwon, since the bulk of the growth took place in 1971-72, indicating a large generation of traffic would occur during the first two years of operation of the new Saemal-Gangreung Highway (Table 16). The normal traffic growth assumed of 12% for cars, 9% for buses and 11.5% for trucks may appear conservative when compared to earlier trends but reflect the slow-down of road transport since 1971 for all the country. (paras 3.04 and 3.05).

B. Gangreung-Mukho (33 km)

4. The existing highway from Gangreung to Mukho (46 km) is paved for about 5 km south from Gangreung. The project highway starts from that point and extends to Mukho. A two-lane paved highway is under construction between Mukho and Samcheok (18 km), financed from the budget. It is scheduled for completion in 1974. The remainder of the existing highway (41 km) between Gangreung and Mukho is unpaved, and has a bad alignment, particularly where it traverses mountainous areas for about half its length, with gradients reaching 10%, and many sharp curves. The surface of river gravel contains many large stones and corrugates badly; average travel speed is about 25 km/h in dry weather, and even less in wet weather. Drainage is poor, and sections on the steeply sloping sea coast are subject to serious landslides and erosion.

5. The new highway (33 km) will be constructed on a more direct alignment, to design standards for new construction (Table 10, Part A), and will be 8.0 km shorter than the existing road. It will have 7.20 m wide asphaltic concrete two-lane pavement, with 1.75 m wide gravel-surfaced shoulders. The terrain is 75% hilly and 25% mountainous. To achieve the improved alignment, gradients will be reduced to a maximum of 8%, and two tunnels 400 m and 450 m long will be constructed in the mountainous areas. The work will include 11 new bridges, the longest being 186 m.

6. Present traffic volume is about 600 adt with a composition of 55% passenger cars, 15% buses and 30% trucks. The average annual growths between 1969 and 1972 were respectively 27%, 12% and 19%. The normal traffic growth rates assumed for the project life are the same as for the Saemal-Gangreung highway but generated traffic rates (Table 16) are somewhat lower since only part of the benefits from the expected induced traffic would be attributed to this road; the other part would accrue to the Gangreung-Sokcho road.

KOREA

SECOND HIGHWAY PROJECT

Description of Project Highways to be Paved

A. Donong-Hoengseong (71 km)

1. There is an existing two-lane paved highway from Seoul to Donong. From there, a further 21 km is presently being paved. The remaining 71 km of unpaved highway to Hoengseong is to be improved and paved under the project. In addition, the Government intends to pave, from other financial sources, the 14 km section from Heongseong to Saemal by the end of 1975; assurances should be obtained, during negotiations, that the Government will have the paving of this section completed by December 31, 1975.

2. The existing road is unpaved and narrow (6 to 7 m wide, including shoulders). The terrain is about 35% flat, 50% rolling and 15% mountainous. Gradients are generally low, except for a few short sections of about 7% to 9% in the mountainous area. Average travel speed in dry weather is about 40 km/h.

3. The improvements to be financed will consist chiefly of reconstructing and widening the existing road, but will also include the improvement of a number of sharp curves and a few short sections of realignment. The standard will be as shown for Paving Type 2 (Table 10, Part B), that is with a 6.70 m wide asphalt concrete pavement and 1.15 m wide gravel shoulders. Existing bridges will be retained except for two, which are narrow and in poor condition, and which will be reconstructed.

4. Present traffic volumes vary between 410 and 190 adt, gradually decreasing from Donong to Heongseong. The traffic composition is about 10% private cars, 5% taxis, 35% buses, 30% trucks and 20% military vehicles. Forecast traffic growth rates are shown in Tables 16 and 17. The influence of the Seoul metropolitan area extends to Yangpyeong where some light industries and services are located. Agriculture, mainly production of rice and cabbages, is rather poor due to unfavorable terrain and soil.

B. Jumunjin-Yangyang (30 km)

5. The road between Gangreung and Sokcho (72 km) is already paved for the two end sections Gangreung-Jumunjin (21 km) and Yangyang-Sokcho (21 km). The center section Jumunjin-Yangyang (30 km) will be improved under the

project. The existing road is unpaved, varies in width from 7 to 10 m including shoulders, and the gravel surface is rough and corrugates under the present volume of traffic; average travel speed is about 40 km/h.

6. From Jumunjin to Yangyang the road will be reconstructed mainly on its present alignment, which is generally fair to good, but some curves will be improved. Most of the existing bridges are adequate and will be retained, but one will be widened and one reconstructed. The improved road will be designed to paving standards, with Type 2 cross section (Table 10, Part B), with an asphalt concrete pavement and gravel surfaced shoulders. The terrain is about 35% rolling and 65% flat.

7. Present traffic volumes range between 300 and 500 adt, with about 15% private cars, 15% taxis, 25% buses, 30% trucks and 15% military vehicles. Forecast traffic growth rates are shown in Tables 16 and 17. The densely populated area lives chiefly on fishing and agriculture from a narrow cultivated strip along the coastline but tourism is also increasing. Pasture is being developed in the hills of the hinterland.

C. Weonju-Maepo (52 km)

8. The present road has a paved surface 6.70 m wide (which is in poor condition) for 3 km at the Weonju end, and for a further 9 km (in good condition) from Jupo to Jecheon. The remaining 49 km of the present road between Weonju, Jecheon and Maepo is unpaved with a width, including shoulders, of 7 m in the flat sections and 5-1/2 - 6 m in the mountainous sections. The terrain is about 60% flat, 30% rolling and 10% mountainous. The horizontal alignment and gradients are reasonable for the terrain. In the mountainous area, the maximum gradient is 5 to 7%, nd some curves need to be improved. Travel speed is 35 to 40 km/h in the flat to rolling terrain and 25 to 30 km/h in the mountainous area.

9. The unpaved total length of 49 km between Weonju-Jupo and Jecheon-Maepo will be reconstructed to Paving Type 2 standards (Table 10, Part B), involving improvement of some substandard curves. The road will receive an asphalt concrete pavement and gravel shoulders. Three narrow bridges are to be widened; three bridges are to be reconstructed and one new one constructed, with spans between 10 and 25 m. The work will also include the repair and strengthening, where required, of the 3 km of existing paved road new Weonju.

10. The present traffic varies between 350 and 600 adt; the highest volumes are near Weonju, the main city at the foothills of an important north-south mountainous range which extends to the east coast. The traffic composition is about 20% for private cars, 10% taxis, 20% buses and 45% trucks; military vehicles are only 5%, although Weonju is a military garrison which occupies a large part of its population (80,000 inhabitants). Agriculture is important in the Jupo area but becomes marginal near Maepo and Danyang where important cement plants are located.

D. Jupo-Hayeong (26 km)

11. The road crosses two mountainous areas separated by a 5 km wide plain. The terrain is about 25% flat, 15% rolling and 60% mountainous. The present road is unpaved with a width, including shoulders, of about 7 m in the valleys and 5-1/2 m in the mountainous sections. The gravel surface contains many large stones and is rough. Maximum gradients are between 5 and 7%. Average travel speed is about 40 km/h in flat sections and 25 km/h in the mountainous sections.

12. The road will be improved to Paving Type 2 (Table 10, Part B) (6.80 m wide asphalt concrete pavement with 1.15 m wide gravel shoulders) for 8 km of flat/rolling terrain and Type 1 (6.00 m wide asphalt concrete pavement and 0.65 m wide gravel shoulders) for 17 km of mountainous terrain. Three narrow bridges are to be widened and one new bridge constructed.

13. Present traffic volumes vary little from 250 to 300 adt at the outskirts of Hayeong; the traffic composition is 5% private cars, 10% taxis, 25% buses and 60% trucks. The main purpose of this short road link is to connect the rich agriculture area along the South Han river new Hayeong to the population centers in the mountainous central range where mineral deposits such as coal are exploited near the towns of Jecheon and Jangseong.

E. Gongju-Gimje (77 km)

14. The road is almost entirely in flat terrain. It is low and poorly drained, and unpaved except for a section of about 9 km in Iri which is not included in the project. The remaining 77 km has a gravel surface which is rough and corrugates in dry weather, and is muddy when wet. The paved length is already constructed to Paving Type 2 standards (Table 10), and is in good condition. The unpaved length is narrow, with a total width of 6 to 7 m, including shoulders, and has many narrow bridges. Travel speeds in dry weather are about 50 km/h in the northern part of the road and about 40 km/h in the south, but speeds are considerably reduced during wet weather.

15. The unpaved sections totalling 77 km will be improved to Paving Type 2 standards (Table 10, Part B) with an asphalt concrete pavement and gravel shoulders. Seventeen bridges will be widened, three reconstructed, and two new bridges built; their spans vary from 6 m to 30 m.

16. The present traffic varies between 260 and 630 adt and builds up mainly near the towns of Nonsan and Iri. The traffic composition is about 10% private cars, 35% taxis, 25% buses and 30% trucks. This area is very densely populated, with numerous large villages. The population lives on a prosperous irrigated agriculture, based on rice and barley, cabbage and other vegetables, poultry and pigs. Iri, with 95,000 inhabitants, is the local capital.

F. Cheongju-Sangju (102 km)

17. The present road is unpaved. Between Cheongju and Boeun (50 km) the terrain is rolling. The alignment is fairly good, but the road is only 7.5 m wide including shoulders, and has a rough gravel surface. Bridges are generally narrow. Average travel speed is about 45 km/h. From Boeun to Sangju (52 km), the road crosses first a flat area, then two mountainous areas separated by a valley, and finally another valley. About 50% is mountainous and 50% flat. In the flat areas, the road is low lying and poorly drained, with a number of fords which are impassible during rainy weather. Maximum gradients in the mountainous areas are between 5 and 7%. The width of road is 6-7 m including shoulders.

18. The road will be reconstructed to Paving standards (Table 10, Part B), Type 3 (7.00 m wide asphalt concrete pavement, with 1.50 m wide gravel shoulders) for 10 km at the Cheongju end, and Type 2 (6.70 m wide asphalt concrete pavement with 1.15 m wide gravel shoulders) for the remaining 40 km to Boeun. Between Boeun and Sangju (52 km), the road will be reconstructed to Type 1 cross-section (6.00 m wide pavement and 0.65 m wide gravel shoulders) for a length of 46 km, and Type 2 for the remaining 6 km to Sangju. The entire 52 km between Boeun and Sangju will have a double bituminous surface treatment which is adequate for the traffic level expected for about 10 years. A total of twelve bridges will be widened, one reconstructed and six new ones built, with spans between 22 m and 132 m.

19. The present traffic ranges between 120 and 860 adt and gradually decreases from Cheongju to Sangju. East of Boeun the traffic is only about 150 adt, but is sufficient to justify the cheaper pavement proposed for this section. Two relatively prosperous agricultural areas, one near Cheongju, the regional capital (150,000 inhabitants), and the other between Boeun and Sangju, support a moderately dense population. Near Boeun the Mount Songni and its temple attract a number of tourists the year around in a growing resort, which is an asset for the region.

G. Jeomchon-Yeongdeog (132 km)

20. The present road is unpaved, except for a length of 7 km through Andong which is not included in the project. Between Jeomchon and Andong (56 km), the road is about 6 m wide, including shoulders, and crosses flat and rolling terrain. Average travel speed is about 35 km/h. Between Andong and Yeongdeog (76 km) the road is between 5 and 6 m wide including shoulders and crosses rolling and mountainous terrain, following river valleys and through mountain passes where gradients reach between 6 and 7%. Average speed in this section is about 30 km/h. Over the entire road, the terrain is about 25% flat, 65% rolling and 10% mountainous. Many bridges are narrow and have inadequate strength and hydraulic capacity.

21. The road will be reconstructed, mainly following the existing alignment but with some improvement of curves. Between Jeomchon and Andong it will be built to Paving Type 2 standards (Table 10, Part B) with an asphalt concrete pavement and gravel shoulders. Between Andong and Yeongdeog, where traffic is lower, standards will be reduced to Type 1 cross section, with pavement of double bituminous surface treatment and gravel shoulders. A total of 21 bridges will be widened, seven reconstructed and seven new ones built.

22. Present traffic volumes vary between 130 and 410 adt, and are particularly light from Jinbo to Yeongdeog. The traffic composition is about 10% private cars, 35% taxes, 25% buses and 30% trucks. The population is concentrated near Jeomchon and Andong, the local capital (71,000 inhabitants). Agriculture is diversified and includes rice, barley, vegetables, grape, apple and pears, and tobacco near Jinbo. Yeongdeog, isolated on the coast, is mainly a fishing harbor for dried fish and crabs, and there are forests in the hinterland.

H. Gwangju-Goheung (102 km)

23. The existing road is unpaved except for short stretches totalling 6 km in Beologyo and villages near Gwangju, which are in poor condition and have narrow shoulders. The first 11 km from Gwanju, through a thickly populated area, crosses rolling terrain and the alignment is good. For the next 49 km toward Beolgyo the road follows a series of river valleys, with mountainous stretches; it has been widened recently and passes through several villages. From Beolgyo to Goheung the terrain is mostly gently rolling. The road is generally 5 to 6 m wide except for sections recently widened, which are about 9 m wide. On the entire road the terrain is about 50% flat, 40% rolling and 10% mountainous. Maximum gradients reach between 5% and 7% in mountainous area. Bridges are generally narrow and in poor structural condition, except in the few recently improved sections. Travel speed is between 35 and 40 km/h.

24. The road will be reconstructed, mainly on the existing alignment, but with improvement of curves, and a few short sections of new alignment. The first 11 km from Gwanju, where traffic is heaviest, will be constructed to Paving Type 3 (Table 10, Part B) with an asphalt concrete pavement and gravel shoulders. The remainder of the road to Goheung will be constructed to Type 2 standards, with an asphalt concrete pavement and gravel shoulders, except for a 15 km section through a mountainous area between Gwangju and Beolgyo, which will be reconstructed to Type 1 standards with an asphalt concrete pavement and gravel shoulders. A total of thirteen bridges will be widened and two reconstructed. On the short sections (6 km) already paved, the surfacing will be repaired, shoulders widened, and drains improved.

25. The present traffic ranges from 220 to 880 adt and gradually decreases from Gwangju to mid-way toward Beolgyo and then increases to

Goheung. The traffic composition is about 10% private cars, 25% taxis, 30% buses and 35% trucks. The regional capital of Gwangju with over 500,000 inhabitants, extends its influcence not much beyond Hwansun, where a hilly and wooded area begins. Population is dense in the Gwangju and Goheung regions and lives on agriculture and light industries, chiefly textiles.

I. Yeongsanpo-Gangjin (42 km)

26. The present highway from Gwangju is paved through Naju to Yeongsanpo, the start of the project road. From there to Gangjin the road is unpaved, except for short lengths in villages, totalling 2 km which are in bad condition. The road has recently been widened to 10 m between Yeongsanpo and Seongjeon (33 km). From Seongjeon to Gangjin (9 km), it is about 7 m wide. The terrain is 80% flat and 20% rolling, and the alignment is fair to good, but bridges are generally narrow and in poor condition. Average travel speed is about 50 km/h.

27. The works to be financed under the project consist of paving the 33 km between Yeongsanpo and Seongjeon to Paving Type 3 cross-section (Table 10, Part B) with an asphalt concrete pavement and gravel shoulders. Between Seongjeon and Gangjin (9 km) the road will be reconstructed and paved to Type 2 standards. A total of ten bridges will be widened, three reconstructed and one new one built. The paved section (total 2 km) through villages will be repaired, shoulders will be widened, and new drains constructed.

28. The present traffic ranges from 450 to 730 adt and decreases gradually toward the south. The traffic composition is about 15% private cars, 20% taxis, 35% buses and 30% trucks. The area served by the road has a moderately dense population living, in many villages, from agriculture based on rice, corn and vegetables which has some development potential through improved cultivation methods as recently demonstrated experimentally in the Mokpo area.

TABLE 1

KOREA

SECOND HIGHWAY PROJECT

Domestic Freight and Passenger Traffic Data, 1967 and 1971

Freight	1967 Ton-Km (million)	1967 (%)	1971 Ton-Km (million)	1971 (%)	1967-71 Average Annual Increase (%)
Highway	660	8.3	3,302	20.9	49.4
Railroad	6,178	78.4	7,841	49.6	6.1
Coastal Shipping	1,043	13.3	4,653	29.5	45.2
Total	7,881	100.0	15,796	100.0	19.0

Passenger	Pass-Km (million)	(%)	Pass-Km (million)	(%)	
Highway	11,699	54.3	22,917	71.1	17.7
Railroad	9,557	44.4	8,750	27.1	-2.1
Coastal Shipping	223	1.0	256	0.8	3.4
Aviation	62	0.3	314	1.0	50.2
Total	21,541	100.0	32,237	100.0	10.6

Source: Statistics Yearbook of Transportation, 1972, Ministry of Transportation

July, 1973

TABLE 2

KOREA

SECOND HIGHWAY PROJECT

Public Transport Investments During Second and Third Five-Year Economic Development Plan, 1967/71, 1972/76
(billion Won)

Transport Mode	Central and Local Governments	
	Second Plan[1/]	Third Plan[2/]
Highways	123.4	227.1
Railroad	85.8	105.6
Ports and Maritime Transport	30.2	60.3
Airports	4.0	11.2
Storage	1.3	15.1
Seoul Subway	-	72.3
Sub-total	244.7	491.6
Total Government Capital Expenditure	904.3	1,864.8
Transport as proportion of total	27%	26%

1/ At current prices for 1967-71
2/ At 1970 prices

Source: Ministry of Construction

July, 1973

TABLE 3

KOREA

SECOND HIGHWAY PROJECT

Public Roads Network, 1971
(km)

Category and Type	Total Length	Paved	(%)	Graveled	(%)	Unsurfaced	(%)
National Highways							
Expressways[1/]	641	641	100	-	-	-	-
Other national highways (primary and secondary)	8,146	2,302	28	5,818	72	26	-
Sub-total	8,787	2,943	33	5,818	66	26	-
Local Roads							
Provincial highways	10,774	254	2	10,064	94	456	4
Special city roads	5,662	1,934	34	3,669	66	59	-
City and county roads	15,412	658	4	12,130	79	2,624	17
Sub-total	31,848	2,846	9	25,863	81	3,139	10
Total	40,635	5,789	14	31,681	78	3,165	8

Road Density in 1971:

Km/Km^2	0.4
Km/1000 inhabitants	1.2

1/ 130 Km are 2 lane non-divided expressways

Source: Ministry of Construction

July, 1973

TABLE 4

KOREA

SECOND HIGHWAY PROJECT

Registered Motor Vehicles, 1962-72

Year	Cars[1/]	Trucks	Buses[2/]	Others[3/]	Total
1962	8,733	13,093	6,747	2,241	30,814
1963	9,569	13,929	8,132	2,598	34,228
1964	11,409	14,951	8,617	2,836	37,813
1965	13,001	16,015	9,316	3,179	41,511
1966	17,502	19,432	10,888	2,338	50,160
1967	23,235	22,955	11,499	3,008	60,697
1968	33,112	31,582	12,786	3,471	80,951
1969	50,299	40,134	14,237	3,999	108,669
1970	60,677	48,901	15,831	3,962	129,371
1971	67,582	53,405	17,411	5,939	144,337
1972	70,250	55,292	17,550	11,770	154,862
		% Average Annual Growth			
1962-71	25.5	16.9	11.1	11.4	18.1
1967-71	30.5	23.5	10.9	18.8	24.2
1970-71	11.4	9.2	10.0	49.9	11.6
1971-72	3.9	3.5	0.8	98.2	7.3
		% Changing Composition			
1962	28.3	42.5	21.8	7.4	100
1967	38.4	37.8	18.9	4.9	100
1971	46.8	37.0	12.1	4.1	100

1 Vehicle per 206 population (1971), compared to 1 per 50 in Thailand and 1 per 63 in the Philippines.

1/ Includes taxis.
2/ Includes microbuses.
3/ Public service, motorcycles, and special vehicles.

Sources: Ministry of Transportation and Mission Estimates, July 1973.

TABLE 5

KOREA

SECOND HIGHWAY PROJECT

Korean Motor Vehicle Production, 1962-72

Year	Cars	Buses	Trucks 1/	Total
1962	991	42	884	1,917
1963	1,430	233	143	1,806
1964	179	405	108	692
1965	166	1,251	965	2,382
1966	3,398	1,482	559	5,439
1967	5,033	941	1,512	7,486
1968	11,421	1,632	5,212	18,265
1969	10,727	1,884	9,626	31,237
1970	13,636	3,690	13,032	30,358
1971	12,428	3,063	7,511	23,002
1972	9,525	2,581	6,542	18,648
		% Average Annual Growth		
1962-71	32.5	62.0	26.8	31.2
1967-71	25.0	34.2	49.1	32.5
1971-72	-23.4	-15.8	-13.0	-18.9

1/ Includes three-wheel vehicles

Source: Ministry of Commerce and Industry

July, 1973

TABLE 6

KOREA

SECOND HIGHWAY PROJECT

Motor Vehicle Fuel Consumption, 1962-72[1/]
(1000 kiloliters)

Year	Gasoline	Diesel
1962	108	225
1963	97	358
1964	102	386
1965	223	507
1966	336	558
1967	481	765
1968	573	1,251
1969	748	1,507
1970	865	1,775
1971	992	2,099
1972	976	2,338
	% Average Annual Growth	
1962-71	27.8	28.3
1967-71	19.8	28.5
1971-72	-1.7	11.4

1/ Gasoline consumption is totally for vehicles, but diesel consumption includes 20-30% of other consumption.

Source: Ministry of Commerce and Industry

July, 1973

TABLE 7

KOREA

SECOND HIGHWAY PROJECT

Highway Authorities and Agencies

	Expressways (tolls)	National Highways		Provincial Highways/1	City/County Roads
Planning	MOC	MOC		8 Provincial Construction Bureaus (PCB)	City/County Construction Sections (CCS), assisted by PCB
Construction					
Design and supervision	Korea Highway Corporation (KHC)	MOC, through its: 5 Regional Construction Bureaus (RCB), when financed domestically; and National H'way Constr. Office (NHCO), when financed with foreign loans		PCB	CCS
Financing	MOC/KHC/2	MOC		Provinces with MOHA grants; also occasional MOC grants for special projects	City/County with Provincial grants
Maintenance					
Executing authority/agency		through 1975/3	from 1976		
Paved	KHC	PCB	MOC	PCB	PCB
Unpaved	-	CCS		CCS	CCS
Financing	KHC	MOC and Provinces	MOC	Provinces with MOHA grants	City/County with Provincial grants

/1 The Special Cities of Seoul and Busan (City Construction Bureaus) have functions similar to Provincial Governments.

/2 KHC was created in January 1969, but has not so far financed any construction.

/3 MOC became responsible for maintenance in one ("pilot") province in September 1972; it is scheduled to take over maintenance in remaining 8 provinces by January 1976.

Source: Ministry of Construction, November 1973

TABLE 8

KOREA

SECOND HIGHWAY PROJECT

Expenditures on Roads, 1962/66 and 1967/71 1/

(million Won)

	Total First Plan 1962/66	1967	1968	1969	1970	1971	Total Second Plan 1967/71
Government Expenditures on National Highways							
Administration	74	12	64	244	307	319	946
Construction	3,811	1,853	13,316	29,192	25,049	19,612	89,022
Maintenance 2/	193	165	240	282	300	461	1,448
Sub-total	4,078	2,030	13,620	29,718	25,656	20,392	91,416
Expenditures on Provincial and County Roads 3/ 4/							
Construction	2,174	1,434	2,843	6,063	7,026	8,920	26,286
Maintenance 5/	851	729	1,004	864	1,226	1,914	5,737
Sub-total	3,025	2,163	3,847	6,927	8,252	10,834	32,023
Total	7,103	4,193	17,467	36,645	33,908	31,226	123,439

1/ At current prices.

2/ Does not include funds contributed by provinces for the maintenance of national highways.

3/ Seoul City excepted.

4/ Includes Government grants.

5/ Maintenance includes expenditure on national highways estimated up to 70% of the total but does not include the value of voluntary labor provided for all highways.

Sources: Ministry of Construction, Ministry of Home Affairs and BCEOM

July, 1973

TABLE 9

KOREA

SECOND HIGHWAY PROJECT

Highway User Charges, 1967-72
(million Won)

Revenue	1967	1968	1969	1970	1971	1972[1/]
National taxes						
Fuel taxes[2/]	4,048	9,680	12,791	16,959	29,083	38,071
Gasoline tax	(2,687)	(6,796)	(9,365)	(12,185)	(21,185)	(27,290)
Diesel tax	(1,361)	(2,884)	(3,426)	(4,774)	(7,898)	(10,781)
Transportation tax	4,025	5,581	8,387	12,238	14,641	16,000
Commodity tax	669	1,075	2,158	5,060	4,465	3,535
Sub-total	8,742	16,336	23,336	34,257	48,189	57,606
Local taxes						
Vehicle tax (incl. surcharge)	1,500	2,488	3,869	5,605	6,393	7,191
License fee and acquisition tax	250	584	881	1,165	1,799	1,661
Sub-total	1,750	3,072	4,750	6,770	8,192	8,852
Tolls	-	6	495	1,987	3,498	4,000
Total	10,492	19,414	28,581	43,014	59,879	70,458

1/ Estimated

2/ Total revenues, not only proportion earmarked for highways

Sources: Ministry of Construction, Ministry of Finance, Ministry of Home Affairs and BCEOM

July, 1973

TABLE 10

KOREA

SECOND HIGHWAY PROJECT

Design Standards for Two-Lane National Highways (Rural)

A. Construction (including paving, mainly on new alignment)

Geometric Design Standards	Unit	Terrain: Flat	Rolling	Hilly	Mountainous[1]
Design speed	km/h	120	100	70	50
Minimum radius of curvature	m	630	390	180	80
Maximum gradient	%	4	5	6.5	8

Roadway Features (all areas)	Unit	
Width of pavement	m	7.20
Width of shoulders	m	3.00-1.75
Width of right-of-way	m	30 minimum[2]

Structural Design Features (all areas)		
Axle-load (pavement)	lbs	18,000[3]
Bridge loading	-	DB-18, equivalent to AASHO H20-S16
Bridge widths (for new bridges) (over 60-100 m long)[4]	m	10.70
Vertical clearance (over roads)	m	4.50

B. Paving (mainly on existing alignment, with limited improvement)

Geometric Design Standards	Unit	Terrain: Flat to Rolling	Hilly	Mountainous[1]
Design speed	km/h	70	55	40
Minimum radius of curvature:				
Desirable	m	250	150	80
Minimum	m	150	80	50
Maximum gradient	%	6	7	8

Roadway Features (all areas)	Unit	Traffic Levels ADT (immediately after completion of paving) <200 Type 1	200-500 Type 2	>500 Type 3
Width of pavement	m	6.00	6.70	7.00
Width of shoulders	m	0.65	1.15	1.50
Width of right-of-way[5]	M	25	25	25

Structural Design Features (all areas)	Unit	
Axle-load (pavement)	lbs	18,000[3]
Bridge loading	-	DB-18, equivalent to AASHO H20-S16
Bridge widths (for new bridges)[6]		
Rural areas	m	8.50
Urban areas	m	10.00
Vertical clearance (over roads)	m	4.50

1/ Design speeds and widths may be reduced and gradients increased on sections with exceptionally difficult terrain, as appropriate to each case.
2/ Right-of-way width increased to 42 m where designed to accomodate ultimate construction of 4-lane divided highway.
3/ Pavement designed for the projected number of repetitions of "equivalent 18,000 lb axle-loads".
4/ Depending on traffic volumes.
5/ Right-of-way width reduced to 20 m where necessary to minimize demolition of property in urban areas.
6/ Existing bridges retained unless significantly substandard in strength, size, or alignment.

Sources: Ministry of Construction, Ingeroute and BCEOM, July, 1973.

TABLE 11

KOREA

SECOND HIGHWAY PROJECT

MOC Field Organization for Maintenance of National Highways

Implementation Schedule

	Action	Implementation Date
1.	Arrange for extension of services of consultants to continue to provide technical assistance for setting up the MOC field organization for highway maintenance.	March 30, 1974
2.	Publish Ministerial Decree authorizing the setting up of 17 MOC Field Sections (Districts), and 30 Sub-Sections (for remaining 8 Provinces) 1/	June 30, 1974
3.	Invite international bids for maintenance and workshop equipment for 2 above.	July 31, 1974
4.	Prepare, with assistance of consultants in 1 above, a detailed program and time schedule for implementing the establishment of the MOC field organization.	September 30, 1974
5.	Evaluate international bids for maintenance and workshop equipment, and award contracts for supply	December 31, 1974
6.	Complete construction of Offices and workshops for the Field Sections and Sub-Sections in 2 above	September 30, 1975
7.	Complete transfer, recruitment and training of staff for Field Sections and Sub-Sections; complete delivery of maintenance and workshop equipment, provide funds, and take over maintenance of national highways in the remaining 8 Provinces.	January 1, 1976

1/ MOC Maintenance Organization for national highways (2 Field Sections, and 2 Field Sub-Sections) in the "pilot" province of Gyeonggi Do was set up and became operational September 1, 1972.

Source: Ministry of Construction, November 1973

TABLE 12

KOREA

SECOND HIGHWAY PROJECT

MOC Field Organization for Maintenance of National Highways:
Maintenance Equipment for Remaining 8 Provinces

Description	Number	Estimated Cost (US$ '000)
Motor Grader	21	706
Wheel Loader	21	504
Dump Truck 4 x 4, 8t	36	432
Dump Truck 4 x 2, 6t	65	455
Dump Truck 4 x 2, 4t	65	325
Portable Asphalt Plant	9	86
Asphalt Distributor	4	82
Portable Air Compressor	28	235
Rock and Concrete Breaker	25	12
Snow Blade	46	166
Line Marker	24	29
Station Wagon (Jeep) 4 x 4	61	256
Pick-up Truck	42	176
Car, sedan	17	51
Emergency Repair Truck	1	15
Tire Roller	6	130
Wheel Roller with Ripper	6	144
Vibrating Roller	16	68
Tandem Roller	23	270
Portable Asphalt Sprayer	15	36
Chipping Spreader	8	12
Water Tank	8	96
Bulldozer	19	912
Tractor and Trailer	4	86
Traffic Counter	19	23
Fork Lift Truck	5	40
Crane 25t	4	180
Street Sweeper	3	45
Guard Rail Cleaner	3	51
Beam Lifter	2	29
Wreck Truck	4	82
Snow Remover	4	46
Sub-total Maintenance Equipment		5,780
Workshop Tools & Machinery (17 Workshops; 7 large, 10 small)		420
Spare Parts		600
Sub-total		6,800
+ 10% Contingency allowance for additional equipment		700
TOTAL		7,500

TABLE 13

KOREA

SECOND HIGHWAY PROJECT

MOC Field Organization for Maintenance of National Highways:
Estimated Capital and Recurrent Costs, 1972-81
(million Won)

	Pilot Province									
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Capital Costs										
Mechanical equipment and tools	40	300	500 1/	2,500 1/	-	-	-	-	-	-
Offices, stores, workshops, etc.	50	-	200	780	-	-	-	-	-	-
Sub-total	90	300	700	3,280	-	-	-	-	-	-
Recurrent Costs										
Staff	20	40	100	350	490	490	490	490	490	490
Maintenance of roads 2/	-	260	400	800	5,050	5,220	5,380	5,440	5,710	5,970
Equipment renewal	-	-	-	-	150	300	450	600	900	1,000
Sub-total	20	300	500	1,150	5,690	6,010	6,320	6,530	7,100	7,460
Total	110	600	1,200	4,430	5,690	6,010	6,320	6,530	7,100	7,460

1/ Total of Won 3,000 million, equivalent to US$7,500,000

2/ Includes labor, materials, fuels and equipment operation

Sources: Ministry of Construction and BCEOM, November 1973

TABLE 14

KOREA

SECOND HIGHWAY PROJECT

Estimated Cost of Project

Item	Length (km)	Won(million) Local	Won(million) Foreign	Won(million) Total	US$(million) Local	US$(million) Foreign	US$(million) Total	% Foreign Exchange Component
A. Highway Construction								
1. Saemal-Gangreung	97	5,210	2,810	8,020	13.1	7.0	20.1	
2. Gangreung-Mukho	33	2,380	1,280	3,660	5.9	3.2	9.1	
Sub-total A	130	7,590	4,090	11,680	19.0	10.2	29.2	35
B. Highway Paving								
1. Donong-Hoengseong	71	1,150	610	1,760	2.9	1.5	4.4	
2. Jumunjin-Yangyang	30	440	230	670	1.1	0.6	1.7	
3. Weonju-Maepo	52	830	450	1,280	2.1	1.1	3.2	
4. Jupo-Hayeong	26	420	230	650	1.0	0.6	1.6	
5. Gongju-Gimje	77	1,350	730	2,080	3.4	1.8	5.2	
6. Cheongju-Sangju	102	1,390	750	2,140	3.4	1.9	5.3	
7. Jeomchon-Yeongdeog	132	1,920	1,030	2,950	4.8	2.6	7.4	
8. Gwangju-Goheung	102	1 480	800	2,280	3.7	2.0	5.7	
9. Yeongsanpo-Gangjin	42	640	350	990	1.6	0.9	2.5	
Sub-total B	634	9,620	5,180	14,800	24.0	13.0	37.0	35
C. Consulting Services								
1. Supervision of A&B		720	720	1,440	1.8	1.8	3.6	50
2. Feasibility studies for improvement/paving of about 1000 km of roads, to be followed by detailed engineering, if found justified		280	280	560	0.7	0.7	1.4	50
Sub-total C		1,000	1,000	2,000	2.5	2.5	5.0	50
D. Highway Maintenance Equipment		1/	3,000	3,000	1/	7.5	7.5	100
E. Contingency Allowances								
1. Physical 2/		1,820	1,330	3,150	4.6	3.3	7.9	
2. Price 3/		2,060	920	2,980	5.2	2.2	7.4	
Sub-total E		3,880	2,250	6,130	9.8	5.5	15.3	
Total Project Cost		22,090	15,520	37,610	55.3	38.7	94.0	41

1/ Small amount for local handling, assembly and transport of imported equipment; also possibly a small amount for local manufacture/assembly, if domestic suppliers submit successful bids for part of the equipment.

2/ 10% on all items.

3/ 12% on local and 10% on foreign cost of construction and paving.

Sources: Ministry of Construction and Consultants' Estimates, November 1973.

TABLE 15

KOREA

SECOND HIGHWAY PROJECT

Schedule of Estimated Disbursements

IBRD Fiscal Year and Quarter	Cumulative Disbursements at End of Quarter (US$ '000)
1973/74	
March 31, 1974	300
June 30, 1974	2,100
1974/75	
September 30, 1974	5,000
December 31, 1974	9,100
March 31, 1975	15,800
June 30, 1975	24,200
1975/76	
September 30, 1975	31,000
December 31, 1975	36,100
March 31, 1976	39,500
June 30, 1976	42,000
1976/77	
September 30, 1976	43,800
December 31, 1976	45,000
March 31, 1977	45,900
June 30, 1977	46,600
1977/78	
September 30, 1977	46,900
December 31, 1977	47,000

Source: Government/Bank Estimates, November 1973

TABLE 16

KOREA

SECOND HIGHWAY PROJECT

Estimated Traffic Growth on Project Rodds

(% p.a.)

	Highway Construction					Highway Paving	
		Generated Traffic					
	Normal Growth	Saemal-Gangreung		Gangreung-Mukho		Normal Growth	
	1972-1995	1976	1977	1976	1977	1972-1976	1976-1991
Cars	12	35	45	25	35	17 [1/]	9
Buses	9	25	40	10	15	12	9
Trucks	11,5	20	30	10	15	13	9
Military Vehicles	0	0	0	0	0	0	0

1/ For highway paving, the growth rate for cars only differs in two cases: Donong-Hoengsong (23%) and Jeomchon-Yeongdeog (20%)

Sources: Consultants'Estimates

August, 1973

KOREA

SECOND HIGHWAY PROJECT

Traffic Volumes on Project Roads

	Road Length Km	Average Annual Daily Traffic 1972 Range	1972 Weighted Average	Forecast 1/ 1976	Forecast 1/ 1986	Forecast 1/ 1995 2/	Average Estimated Traffic Growth (% p.a.) 1972-76	Average Estimated Traffic Growth (% p.a.) 1976-95 2/
A. Highway Construction								
1. Saemal-Gangreung	97	370-880	413	710	2,610	6,910	14.2	12.0
2. Gangreung-Mukho	33	600-630	619	875	3,200	8,560	14.7	12.0
B. Highway Paving								
1. Donong-Hoengseong	71	190-410	265	430	970	1,480	12.9	8.6
2. Jumunjin-Yangyang	30	300-500	370	636	1,430	2,180	14.5	8.5
3. Weonju-Maepo	52	350-600	400	718	1,670	2,560	15.7	8.9
4. Jupo-Hayeong	26	250-300	270	492	1,165	1,790	16.2	9.0
5. Gongju-Gimje	77	260-630	370	633	1,490	2,300	14.4	9.0
6. Cheongju-Sangju	102	120-860	354	586	1,390	2,130	13.4	9.0
7. Jeomchon-Yeongdeog	132	130-410	321	560	1,320	2,020	14.9	9.0
8. Gwangju-Goheung	102	220-880	328	581	1,370	2,110	15.4	9.0
9. Yeongsanpo-Gangjin	42	450-730	620	1,125	2,650	4,070	16.0	9.0

1/ Traffic forecasts for the two highways to be constructed include, in addition to generated traffic, the traffic diverted from the existing highways and from railways and airlines; the volume diverted from the last two modes represent less than 5% each of the total traffic of the new highways.

2/ For the highways to be paved, the forecast figures apply up to 1991 and not to 1995, the life of this part of the project being 16 years instead of 20.

Sources: Consultants' and Mission Estimates

August, 1973

TABLE 1/

KOREA

SECOND HIGHWAY PROJECT

Estimated Average Vehicle Operating Costs and Savings on Project Roads

(Won per km, excluding taxes)

	Private Cars				Taxies				Buses				Trucks			
	Existing Road	Improved Road	Savings per Km.	%	Existing Road	Improved Road	Savings per Km.	%	Existing Road	Improved Road	Savings per Km.	%	Existing Road	Improved Road	Savings per Km.	%
Excluding Passengers' Time Savings																
A. Highway Construction																
1. Saemal-Gangreung	41.0	26.0	15.0	37	NA 1/	NA	NA	-	117.0	63.0	54.0	46	113.0	57.0	56.0	49
2. Gangreung-Mukho	40.0	25.0	15.0	37	NA	NA	NA	-	116.0	61.0	55.0	47	112.0	56.0	56.0	50
B. Highway Paving																
1. Donong-Hoengseong	32.8	27.7	5.1	15	39.7	25.7	14.0	35	106.4	70.0	36.4	34	92.0	64.1	27.9	30
2. Jumunjin-Yangyang	31.8	26.8	5.0	16	39.4	24.8	14.6	37	97.8	63.8	34.0	35	85.2	58.4	26.8	31
3. Weonju-Maepo	32.8	27.7	5.1	15	39.7	25.7	14.0	35	106.4	70.0	36.4	34	92.0	64.1	27.9	30
4. Jupo-Hayeong	34.3	28.7	6.3	18	40.9	26.7	14.2	35	119.9	80.0	39.9	33	103.5	73.6	29.9	29
5. Gongju-Gimje	31.0	26.0	5.0	16	39.0	24.0	15.0	38	91.0	59.0	32.0	35	80.0	54.0	26.0	32
6. Cheongju-Sangju	31.8	26.8	5.0	16	39.4	24.8	14.6	37	97.8	63.8	34.0	35	85.2	58.4	26.8	31
7. Jeomchon-Yeongdeog	32.8	27.7	5.1	15	39.7	25.7	14.0	35	106.4	70.0	36.4	34	92.0	64.1	27.9	30
8. Gwangju-Goheung	32.3	27.7	5.1	15	39.7	25.7	14.0	35	106.4	70.0	36.4	34	92.0	64.1	27.9	30
9. Yeongsanpo-Gangjin	31.8	26.8	5.0	16	39.4	24.8	14.6	37	97.8	63.8	36.0	35	85.2	58.4	26.8	31
Including Passengers' Time Savings																
A. Highway Construction																
1. Saemal-Gangreung	46.0	29.0	17.0	37	NA	NA	NA	-	143.0	77.0	66.0	46	NA	NA	-	-
2. Gangreung-Mukho	45.0	28.0	17.0	37	NA	NA	NA	-	142.0	75.0	67.0	47	NA	NA	-	-
B. Highway Paving																
1. Donong-Hoengseong	37.6	31.5	6.1	16	43.8	28.5	15.3	35	129.0	85.9	43.1	33	NA	NA	-	-
2. Jumunjin-Yangyang	36.2	30.2	6.0	20	42.8	27.2	15.6	36	118.4	78.0	40.4	34	NA	NA	-	-
3. Weonju-Maepo	37.6	31.5	6.1	16	43.8	28.5	15.3	35	129.0	85.9	43.1	30	NA	NA	-	-
4. Jupo-Hayeong	39.6	32.0	7.6	20	45.3	30.0	15.3	34	146.7	99.4	47.3	32	NA	NA	-	-
5. Gongju-Gimje	35.0	29.0	6.0	21	42.0	26.0	16.0	38	110.0	72.0	38.0	35	NA	NA	-	-
6. Cheongju-Sangju	36.2	30.2	6.0	20	42.8	27.2	15.6	36	118.4	78.0	40.4	34	NA	NA	-	-
7. Jeomchon-Yeongdeog	37.6	31.5	6.1	16	43.8	28.5	15.3	35	129.0	85.9	43.1	33	NA	NA	-	-
8. Gwangju-Goheung	37.6	31.5	6.1	16	43.8	28.5	15.3	35	129.0	85.9	43.1	33	NA	NA	-	-
9. Yeongsanpo-Gangjin	36.2	30.2	6.0	20	42.8	27.2	15.6	36	118.4	78.0	40.4	34	NA	NA	-	-

Sources: Consultants' and Mission's Estimates

1/ NA = Not Applicable

August, 1973

TABLE 13

KOREA

SECOND HIGHWAY PROJECT

Highway Maintenance Program

Estimated Vehicle Operating Cost and Savings

(Won per km, excluding taxes)

	Paved Roads				Gravel Roads			
	Present Maintenance	Improved Maintenance	Savings	%	Present Maintenance	Improved Maintenance	Savings	%
Private Cars	28.3	27.7	0.6	2	32.3	30.7	1.6	5
Taxies	26.5	25.7	0.7	3	39.7	36.9	2.8	7
Buses	74.5	70.0	4.5	6	106.4	90.5	15.9	15
Trucks	68.2	64.1	4.1	6	92.0	78.2	13.8	15

Sources: Consultants' and Mission's Estimates

August, 1973

KOREA

TABLE 20
Page 1

SECOND HIGHWAY PROJECT

Estimated Costs and Benefits Streams

(million Won)

Highway Construction

1. Saemal-Gangreung

Year	Costs				Benefits			
	Construction, Right of Way and Supervision	Maintenance: Gravel Existing Road	Maintenance: Paved New Road	Total Cost	Operating Cost Savings: Without Time	Operating Cost Savings: With Time	Net Benefits: Without Time	Net Benefits: With Time
	(1)	(2)	(3)	(4)=(1)+(3)-(2)	(5)	(6)	(7)=(5)-(4)	(8)=(6)-(4)
1973	832.00			832.00			-832.00	-832.00
1974	4,160.00			4,160.00			-4,160.00	-4,160.00
1975	3,328.00			3,328.00			-3,328.00	-3,328.00
1976		45.37	25.64	-19.73	1,513.75	1,648.48	1,533.48	1,668.21
1977		45.37	25.64	-19.73	1,852.60	2,017.48	1,872.33	2,037.21
1978		45.37	26.31	-19.06	2,055.00	2,237.89	2,074.06	2,246.95
1979		45.37	26.31	-19.06	2,279.58	2,482.47	2,298.64	2,501.55
1980		45.37	26.31	-19.06	2,528.89	2,753.97	2,547.95	2,773.03
1981		45.37	26.31	-19.06	2,806.02	3,055.75	2,825.08	3,074.81
1982		57.50	26.31	-31.19	3,113.83	3,390.96	3,145.02	3,422.15
1983		57.50	26.31	-31.19	3,455.79	3,763.35	3,486.98	3,794.54
1984		57.50	29.51	-27.99	3,835.60	4,176.97	3,863.59	4,204.69
1985		57.50	434.72	377.22	4,257.69	4,636.62	3,880.47	4,259.40
1986		57.50	29.51	-27.99	4,726.80	4,997.49	4,754.79	5,025.48
1987		57.50	29.51	-27.99	5,248.23	5,715.31	3,554.80	5,743.30
1988		57.50	29.51	-27.99	5,827.68	6,346.35	5,855.67	6,374.34
1989		71.25	32.95	-38.30	6,471.84	7,047.84	6,510.14	7,086.14
1990		71.25	32.95	-38.30	7,188.00	7,827.73	7,226.30	7,866.03
1991		71.25	32.95	-38.30	7,984.15	8,694.75	8,022.45	8,733.05
1992		71.25	32.95	-38.30	8,869.39	9,658.77	8,907.69	9,697.07
1993		71.25	438.16	366.91	9,853.72	10,730.70	9,486.81	10,363.79
1994		71.25	32.95	-38.30	10,812.75	11,775.09	10,851.05	11,813.39
1995		71.25	-256.48	-327.73	11,785.89	12,834.84	12,113.62	13,162.57
							IRR=26.25	IRR=27.90

Sources: Consultants' and Mission's Estimates

August, 1973

SECOND HIGHWAY PROJECT

Estimated Costs and Benefits Streams

(million Won)

Highway Construction

2. Gangreung-Mukho

Year	Costs				Benefits			
	Construction, Right of Way and Supervision	Maintenance: Gravel Existing Road	Maintenance: Paved New Road	Total Cost	Operating Cost Savings: Without Time	Operating Cost Savings: With Time	Net Benefits: Without Time	Net Benefits: With Time
	(1)	(2)	(3)	(4)=(1)+(3)-(2)	(5)	(6)	(7)=(5)-(4)	(8)=(6)-(4)
1973	379.00			379.00			-379.00	-379.00
1974	1,895.00			1,895.00			-1,895.00	-1,895.00
1975	1,516.00			1,516.00			-1,516.00	-1,516.00
1976		13.79	5.24	-8.55	572.18	620.25	580.73	628.80
1977		13.79	5.45	-8.34	679.81	736.92	688.15	745.26
1978		17.48	5.45	-12.03	755.04	818.46	767.07	830.49
1979		17.48	5.45	-12.03	838.77	909.23	850.80	921.26
1980		17.48	5.45	-12.03	931.85	1,010.13	943.88	1,022.16
1981		17.48	5.45	-12.03	1,035.63	1,122.62	1,047.66	1,134.65
1982		17.48	5.45	-12.03	1,151.08	1,247.77	1,163.11	1,259.80
1983		17.48	5.45	-12.03	1,279.44	1,386.92	1,291.47	1,398.95
1984		17.48	5.45	-12.03	1,422.21	1,541.67	1,434.24	1,553.70
1985		21.66	129.97	108.31	1,581.04	1,713.85	1,562.73	1,605.54
1986		21.66	5.65	-16.01	1,757.72	1,905.37	1,773.73	1,921.38
1987		21.66	5.65	-16.01	1,954.45	2,118.63	1,970.46	2,134.64
1988		21.66	5.65	-16.01	2,173.28	2,355.83	2,189.29	2,371.84
1989		21.66	5.65	-16.01	2,416.67	2,619.67	2,432.68	2,635.68
1990		21.66	5.65	-16.01	2,687.66	2,913.43	2,703.67	2,929.44
1991		21.66	5.65	-16.01	2,989.27	3,240.36	3,005.28	3,256.37
1992		21.66	5.65	-16.01	3,324.91	3,604.21	3,340.92	3,620.22
1993		21.66	129.97	108.31	3,698.45	4,009.13	3,590.14	3,900.82
1994		21.66	5.65	-16.01	4,114.68	4,460.32	4,130.69	4,476.33
1995		21.66	-83.15	-104.81	4,567.29	4,950.97	4,672.10	5,055.78
							IRR=23.45	IRR=24.70

Sources: Consultants' and Mission's Estimates

August, 1973

KOREA

TABLE 21

Page 1

SECOND HIGHWAY PROJECT

Estimated Costs and Benefits Streams

(million Won)

Highway Paving

1. Donong-Hoengseong

Year	Costs				Benefits			
	Construction, Right of Way and Supervision	Maintenance: Gravel Existing Road	Maintenance: Paved New Road	Total Cost	Operating Cost Savings: Without Time	Operating Cost Savings: With Time	Net Benefits: Without Time	Net Benefits: With Time
	(1)	(2)	(3)	(4)=(1)+(3)-(2)	(5)	(6)	8=(5)-(4)	7=(6)-(4)
1974	863.19			863.19			-863.19	-863.19
1975	863.19			863.19	69.49	77.48	-793.70	-785.71
1976		21.20	12.22	-8.98	310.16	345.83	319.14	354.81
1977		21.20	12.22	-8.98	335.55	374.14	344.53	383.12
1978		22.12	12.30	-9.82	363.23	405.00	373.05	414.82
1979		22.12	12.30	-9.82	393.39	438.63	403.21	448.45
1980		22.12	12.30	-9.82	426.28	475.30	436.10	485.12
1981		24.04	12.44	-11.60	462.12	515.26	473.72	526.86
1982		27.13	12.69	-14.44	501.18	558.82	515.62	573.26
1983		27.41	12.72	-14.69	543.77	606.30	558.46	620.99
1984		27.41	12.72	-14.69	590.18	658.05	604.87	672.74
1985		27.41	297.26	269.85	640.78	714.47	370.93	444.62
1986		27.41	12.72	-14.69	695.92	775.95	710.61	790.64
1987		28.45	12.80	-15.65	756.03	842.97	771.68	858.62
1988		28.45	12.80	-15.65	821.55	916.03	837.20	931.68
1989		31.09	12.97	-18.12	892.97	995.66	911.09	1,013.78
1990		34.57	13.22	-21.35	970.82	1,082.46	992.17	1,103.81
1991		34.57	-100.60	-135.17	1,055.66	1,177.06	1,190.83	1,312.23
							IRR=23.05	IRR=25.22

Sources: Consultants' and Mission's Estimates

August, 1973

KOREA

TABLE 21
Page 2

SECOND HIGHWAY PROJECT

Estimated Costs and Benefits Streams

(million Won)

Highway Paving

2. Jumunjin-Yangyang

Year	Costs				Benefits			
	Construction, Right of Way and Supervision	Maintenance: Gravel Existing Road	Maintenance: Paved New Road	Total Cost	Operating Cost Savings: Without Time	Operating Cost Savings: With Time	Net Benefits: Without Time	Net Benefits: With Time
	(1)	(2)	(3)	(4)=(1)+(3)-(2)	(5)	(6)	(7)=(5)-(4)	(8)=(6)-(4)
1974	332.16			332.16			-332.16	-332.16
1975	332.16			332.16	33.94	36.86	-298.22	-295.30
1976		10.95	5.34	-5.61	151.99	165.06	157.60	171.67
1977		10.95	5.34	-5.61	164.37	178.51	169.98	184.12
1978		10.95	5.34	-5.61	177.88	193.18	183.49	198.79
1979		10.95	5.34	-5.61	192.60	209.16	198.21	214.77
1980		10.95	5.34	-5.61	208.64	225.58	214.25	232.19
1981		10.95	5.34	-5.61	226.13	245.58	213.74	251.19
1982		13.87	5.55	-8.32	245.19	266.28	253.51	274.60
1983		13.87	5.55	-8.32	265.97	288.84	274.29	297.16
1984		13.87	5.55	-8.32	288.62	313.44	296.94	321.76
1985		13.87	126.79	112.92	313.31	340.25	200.39	227.33
1986		13.87	5.55	-8.32	340.22	369.48	348.54	377.80
1987		13.87	5.55	-8.32	369.54	401.32	377.86	409.64
1988		13.87	5.55	-8.32	401.52	436.05	409.84	444.37
1989		13.87	5.55	-8.32	436.36	473.89	444.68	482.21
1990		17.19	5.76	-11.43	474.34	515.13	485.77	526.56
1991		17.19	-42.74	-59.93	515.74	560.09	575.67	620.02
							IRR=28.25	IRR=30.22

Sources: Consultants' and Mission's Estimates

August, 1973

KOREA

TABLE 21
Page 3

SECOND HIGHWAY PROJECT

Estimated Costs and Benefits Streams

(million Won)

Highway Paving

3. Weonju-Maepo

Year	Costs				Benefits			
	Construction, Right of Way and Supervision	Maintenance: Gravel Existing Road	Maintenance: Paved New Road	Total Cost	Operating Cost Savings: Without Time	Operating Cost Savings: With Time	Net Benefits: Without Time	Net Benefits: With Time
1974	653.53			653.53			-653.53	-653.53
1975	653.53			653.53	71.49	76.78	-582.04	-576.75
1976		18.70	9.12	-9.58	320.79	344.53	330.37	354.11
1977		18.70	9.12	-9.58	348.72	374.53	358.30	384.11
1978		18.70	9.12	-9.58	379.16	407.22	388.74	416.80
1979		18.70	9.12	-9.58	412.34	442.85	421.92	452.43
1980		23.70	9.48	-14.22	448.51	481.70	462.73	495.92
1981		23.70	9.48	-14.22	487.92	524.03	502.14	538.25
1982		23.70	9.48	-14.22	530.90	570.19	545.12	584.41
1983		23.70	9.48	-14.22	577.74	620.49	591.96	634.71
1984		23.70	9.48	-14.22	628.78	675.31	643.00	689.53
1985		23.70	216.59	192.89	684.43	735.08	491.54	542.19
1986		23.70	9.48	-14.22	745.09	800.23	759.31	814.45
1987		23.70	9.48	-14.22	811.20	871.23	825.42	885.45
1988		23.70	9.48	-14.22	883.27	948.63	897.49	962.85
1989		29.37	9.84	-19.53	961.82	1,032.99	981.35	1,052.52
1990		29.37	9.84	-19.53	1,047.44	1,124.95	1,066.97	1,144.48
1991		29.37	-73.00	-102.37	1,140.76	1,225.18	1,243.13	1,327.55
							IRR=30,27	IRR=32.02

Sources: Consultants' and Mission's Estimates

August, 1973

KOREA

TABLE 21
Page 4

SECOND HIGHWAY PROJECT

Estimated Costs and Benefits Streams

(million Won)

Highway Paving

[illegible]ayeong

Year	Costs				Benefits			
	Construction, Right of Way and Supervision	Maintenance: Gravel Existing Road	Maintenance: Paved New Road	Total Cost	Operating Cost Savings: Without Time	Operating Cost Savings: With Time	Net Benefits: Without Time	Net Benefits: With Time
1974	321.01			321.01			-321.01	-321.01
1975	321.01			321.01	33.33	35.76	-287.68	-285.25
1976		7.33	4.50	-2.83	150.47	161.45	153.30	164.28
[illegible]7		9.60	4.68	-4.92	164.02	175.99	168.94	180.91
1978		9.60	4.68	-4.92	178.78	191.83	183.70	196.75
[illegible]		9.60	4.68	-4.92	194.87	209.10	199.79	214.02
1980		9.60	4.68	-4.92	212.41	227.92	217.33	232.84
1981		9.60	4.68	-4.92	231.53	248.43	236.45	253.35
1982		9.60	4.68	-4.92	252.36	270.78	257.28	275.70
1983		9.60	4.68	-4.92	275.07	295.15	279.99	300.07
1984		9.60	4.68	-4.92	299.83	321.72	304.75	326.64
1985		12.16	100.09	87.93	326.82	350.68	238.89	262.75
1986		12.16	4.87	-7.29	356.23	332.23	363.52	389.52
1987		12.16	4.87	-7.29	388.28	416.62	395.57	423.91
1988		12.16	4.87	-7.29	423.23	454.13	430.52	461.42
1989		12.16	4.87	-7.29	461.32	495.00	468.61	502.29
1990		12.16	4.87	-7.29	502.84	539.55	510.13	546.84
1991		12.16	-33.22	-45.38	548.10	588.11	593.48	633.49
							IRR=29.27	IRR=30.94

Sources: Consultants' and Mission's Estimates

August, 1973

KOREA

SECOND HIGHWAY PROJECT

Estimated Costs and Benefits Streams

(million Won)

Highway Paving

5. Gongju-Gimje

	Costs				Benefits			
		Maintenance			Operating Cost Savings		Net Benefits	
	Construction, Right of Way and Supervision	Gravel Existing Road	Paved New Road	Total Cost	Without Time	With Time	Without Time	With Time
1974	1,102.54			1,102.54			-1,102.54	-1,102.54
1975	1,102.55			1,102.54	78.74	85.98	-1,023.80	-1,016.56
1976		25.61	13.37	-12.24	357.76	390.67	370.00	402.91
1977		26.38	13.43	-12.95	389.84	425.71	402.79	438.66
1978		28.56	13.61	-14.95	424.79	463.87	439.74	478.82
1979		28.56	13.61	-14.95	462.90	505.49	477.85	520.44
1980		28.56	13.61	-14.95	504.43	550.84	519.38	565.79
1981		28.56	13.61	-14.95	549.70	600.27	564.65	615.22
1982		32.76	13.91	-18.85	599.06	654.17	617.91	673.02
1983		32.76	13.91	-18.85	652.84	712.90	671.69	731.75
1984		32.76	13.91	-18.85	711.47	776.93	730.32	795.78
1985		33.63	379.62	345.99	775.38	846.71	429.39	500.72
1986		36.08	14.14	-21.94	845.04	922.78	866.98	944.72
1987		36.08	14.14	-21.94	920.97	1,005.70	942.91	1,027.64
1988		36.08	14.14	-21.94	1,003.73	1,096.07	1,025.67	1,118.01
1989		36.08	14.14	-21.94	1,093.94	1,194.58	1,115.88	1,216.52
1990		40.85	14.45	-26.40	1,192.27	1,301.96	1,218.67	1,328.36
1991		40.85	-131.79	-172.64	1,299.45	1,419.00	1,472.09	1,591.64
							IRR=21.62	IRR=23.28

Sources: Consultants' and Mission's Estimates

August, 1973

KOREA

TABLE 21
Page 6

SECOND HIGHWAY PROJECT

Estimated Costs and Benefits Streams

(million Won)

Highway Paving

6. Cheongju-Sangju

Year	Costs				Benefits			
	Construction, Right of Way and Supervision	Maintenance: Gravel Existing Road	Maintenance: Paved New Road	Total Cost	Operating Cost Savings: Without Time	Operating Cost Savings: With Time	Net Benefits: Without Time	Net Benefits: With Time
1974	1,079.31			1,079.31			-1,079.31	-1,079.31
1975	1,079.31			1,079.31	116.23	128.90	-963.08	-950.41
1976		30.74	17.45	-13.29	524.51	581.68	537.80	594.97
1977		30.74	17.45	-13.29	571.61	633.92	584.90	647.21
1978		30.74	17.45	-13.29	622.95	690.85	636.24	704.14
1979		30.74	17.45	-13.29	678.91	752.91	692.20	766.20
1980		35.67	205.47	169.80	739.92	820.57	570.12	650.77
1981		39.06	18.17	-20.89	806.40	894.30	827.29	915.19
1982		39.06	18.17	-20.89	878.87	974.67	899.76	995.56
1983		39.06	18.17	-20.89	957.87	1,062.28	978.76	1,083.17
1984		39.06	61.09	22.03	1,043.97	1,157.76	1,021.96	1,135.73
1985		39.06	180.20	141.14	1,137.82	1,261.84	996.68	1,120.70
1986		39.06	18.17	-20.89	1,240.12	1,375.29	1,261.01	1,396.18
1987		42.96	18.48	-24.48	1,351.62	1,498.95	1,376.10	1,523.43
1988		47.39	18.77	-29.22	1,473.16	1,633.73	1,502.38	1,662.95
1989		47.99	18.77	-29.22	1,605.64	1,780.65	1,634.86	1,809.87
1990		47.99	206.79	158.80	1,750.05	1,940.81	1,591.25	1,782.01
1991		47.99	-220.73	-268.72	1,907.45	2,115.36	2,176.17	2,384.08
							IRR=29.71	IRR=32.25

Sources: Consultants' and Missions's Estimates

August, 1973

KOREA

SECOND HIGHWAY PROJECT

Estimated Costs and Benefits Streams

(million Won)

Highway Paving

7. Jeomchon-Yeongdeog

Year	Costs				Benefits			
	Construction, Right of Way and Supervision	Maintenance: Gravel Existing Road	Maintenance: Paved New Road	Total Cost	Operating Cost Savings: Without Time	Operating Cost Savings: With Time	Net Benefits: Without Time	Net Benefits: With Time
1974	1,532.74			1,532.74			-1,532.74	-1,532.74
1975	1,532.74			1,532.74	134.21	146.21	-1,398.53	-1,386.05
1976		43.12	22.94	-20.18	610.62	667.41	630.80	687.59
1977		43.12	22.94	-20.18	664.50	726.30	684.68	746.48
1978		43.12	22.94	-20.18	723.22	790.48	743.40	810.66
1979		45.18	23.17	-22.01	787.23	860.44	809.24	882.45
1980		50.62	141.22	90.60	857.00	936.70	766.40	846.10
1981		50.62	23.56	-27.06	933.04	1,019.81	960.10	1,046.87
1982		50.62	23.56	-27.06	1,015.94	1,110.42	1,043.00	1,137.48
1983		54.83	23.87	-30.96	1,106.29	1,209.17	1,137.25	1,240.13
1984		54.83	23.87	-30.96	1,204.78	1,316.82	1,235.74	1,347.78
1985		57.65	435.56	377.89	1,312.12	1,434.15	934.23	1,056.26
1986		57.65	24.10	-33.55	1,429.13	1,562.04	1,462.68	1,595.59
1987		57.65	24.10	-33.55	1,556.68	1,701.45	1,590.23	1,735.00
1988		63.81	24.49	-39.82	1,695.70	1,853.40	1,735.52	1,893.22
1989		63.81	24.49	-39.82	1,847.23	2,019.02	1,887.05	2,058.84
1990		63.81	142.15	78.34	2,012.39	2,199.54	1,934.05	2,121.20
1991		63.81	-245.98	-309.79	2,192.43	2,396.33	2,502.22	2,706.12
							IRR=25.46	IRR=27.34

Sources: Consultants' and Mission's Estimates

August, 1973

SECOND HIGHWAY PROJECT

Estimated Costs and Benefits Streams
(million Won)

Highway Paving

8. Gwangju-Gohsung

Year	Costs				Benefits			
	Construction, Right of Way and Supervision	Maintenance: Gravel Existing Road	Maintenance: Paved New Road	Total Cost	Operating Cost Savings: Without Time	Operating Cost Savings: With Time	Net Benefits: Without Time	Net Benefits: With Time
1974	1,178.56			1,178.56			-1,178.56	-1,178.56
1975	1,178.57			1,178.57	111.14	121.81	-1,067.42	-1,056.75
1976		32.56	17.63	-14.93	502.84	551.11	517.77	566.04
1977		35.44	17.87	-17.57	547.77	600.36	563.34	617.93
1978		35.44	17.87	-17.57	596.73	654.02	614.30	671.59
1979		35.44	17.87	-17.57	650.10	712.51	667.67	730.08
1980		36.67	17.94	-18.73	708.28	776.27	727.01	795.00
1981		36.67	17.94	-18.73	771.69	845.77	790.42	864.50
1982		36.99	17.97	-19.02	840.81	921.53	859.83	940.55
1983		40.69	18.24	-22.45	916.15	1,004.10	938.60	1,026.55
1984		41.66	65.30	23.64	998.27	1,094.10	974.63	1,070.46
1985		44.90	376.67	331.77	1,087.78	1,192.21	756.01	860.44
1986		44.90	18.58	-26.32	1,185.35	1,299.14	1,211.67	1,325.46
1987		44.90	18.58	-26.32	1,291.70	1,415.70	1,318.02	1,442.02
1988		44.90	18.58	-26.32	1,407.62	1,542.75	1,433.94	1,569.07
1989		44.90	18.58	-26.32	1,533.97	1,681.23	1,560.29	1,707.55
1990		46.59	18.71	-27.88	1,671.69	1,832.17	1,699.57	1,860.05
1991		50.78	-130.40	-181.18	1,821.81	1,996.70	2,002.99	2.177.88
							IRR=27.15	IRR=29.17

Sources: Consultants' and Mission's Estimates

August, 1973

KOREA

SECOND HIGHWAY PROJECT

Estimated Costs and Benefits Streams

(million Won)

Highway Paving

9. Yeongsanpo-Gangjin

Year	Costs				Benefits			
	Construction, Right of Way and Supervision	Maintenance: Gravel Existing Road	Maintenance: Paved New Road	Total Cost	Operating Cost Savings: Without Time	Operating Cost Savings: With Time	Net Benefits: Without Time	Net Benefits: With Time
1974	483.54			483.54			-483.54	-483.54
1975	483.55			483.54	87.88	97.20	-395.66	-386.34
1976		19.28	7.71	-11.57	397.27	439.38	408.84	450.95
1977		19.28	7.71	-11.57	432.66	478.52	444.23	490.09
1978		19.28	7.71	-11.57	471.25	521.20	482.82	532.77
1979		19.28	7.71	-11.57	513.31	567.72	524.88	579.29
1980		19.28	7.71	-11.57	559.15	618.42	570.72	629.99
1981		19.28	7.71	-11.57	609.12	673.69	620.69	685.26
1982		19.28	7.71	-11.57	663.57	733.91	675.14	745.48
1983		23.89	8.01	-15.88	722.94	799.57	738.82	815.45
1984		23.89	8.01	-15.88	787.65	871.14	803.53	887.02
1985		23.89	184.03	160.14	858.18	949.15	698.04	789.01
1986		23.89	8.01	-15.88	935.07	1,034.19	950.95	1,050.07
1987		23.89	8.01	-15.88	1,018.86	1,126.86	1,034.74	1,142.74
1988		23.89	8.01	-15.88	1,110.20	1,227.88	1,126.08	1,243.76
1989		23.89	8.01	-15.88	1,209.76	1,337.99	1,225.64	1,353.87
1990		23.89	8.01	-15.88	1,318.29	1,458.03	1,334.17	1,473.91
1991		23.89	-62.40	-86.29	1,436.58	1,588.86	1,522.87	1,675.15
							IRR=45.48	IRR=49.14

Sources: Consultants' and Mission's Estimates

August, 1973

KOREA

TABLE 22

SECOND HIGHWAY PROJECT

Highway Maintenance Program: Economic Evaluation, 1974-81

(million Won)

Year	Costs			Benefits			Net Benefits
	Capital Expenditures	Increase in Recurrent Expenditures	Total Increase in Costs	Vehicle Operating Cost Savings			
				Paved Roads	Gravel Roads	Total	
	(1)	(2)	(3)=(1)+(2)	(5)	(6)	(7)	(8)=(7)-(4)
1974	3,980	-	3,980	-	-	-	-3,980
1975	50	4,380	4,430	1,313	1,732	3,045	-1,385
1976	150	4,540	4,690	3,086	3,120	6,206	1,516
1977	300	4,710	5,010	5,414	4,021	9,435	4,425
1978	450	4,870	5,320	8,444	4,139	12,543	7,223
1979	600	4,930	5,530	9,869	3,145	13,014	7,484
1980	900	5,200	6,100	11,531	509	12,110	6,040
1981	1,000	5,460	6,460	12,812	-	12,812	6,352

IRR= 53.04

Sources: Consultants' and Mission's Estimates

August, 1973

KOREA

SECOND HIGHWAY PROJECT

Economic Returns and Sensitivity Analysis

(%)

	Best Estimate	High 1/ Estimate	Low 2/ Estimate	Passenger Time Saving Excluded from Benefits
A. Highway Construction				
1. Saemal Gangreung	28	34	21	26
2. Gangreung Mukho	25	32	19	23
B. Highway Paving				
1. Donong-Hoengseong	25	34	17	23
2. Jumunjin-Yangyang	30	41	21	28
3. Weonju-Maepo	32	43	23	30
4. Jupo-Hayeong	31	41	22	29
5. Gongju-Gimje	23	32	16	22
6. Cheongju-Sangju	32	44	23	30
7. Jeomchon-Yeongdeog	27	37	19	25
8. Gwangju-Goheung	29	39	21	27
9. Yeongsanpo-Gangjin	49	66	35	45
C. Highway Maintenance Program				
National Roads Network (8150 Km)	53	85	21	-

1/ Assumes costs 15% lower and benefits 25% higher than in the best estimate, excepted for the maintenance program where figures are reduced to 10% and 20% respectively.

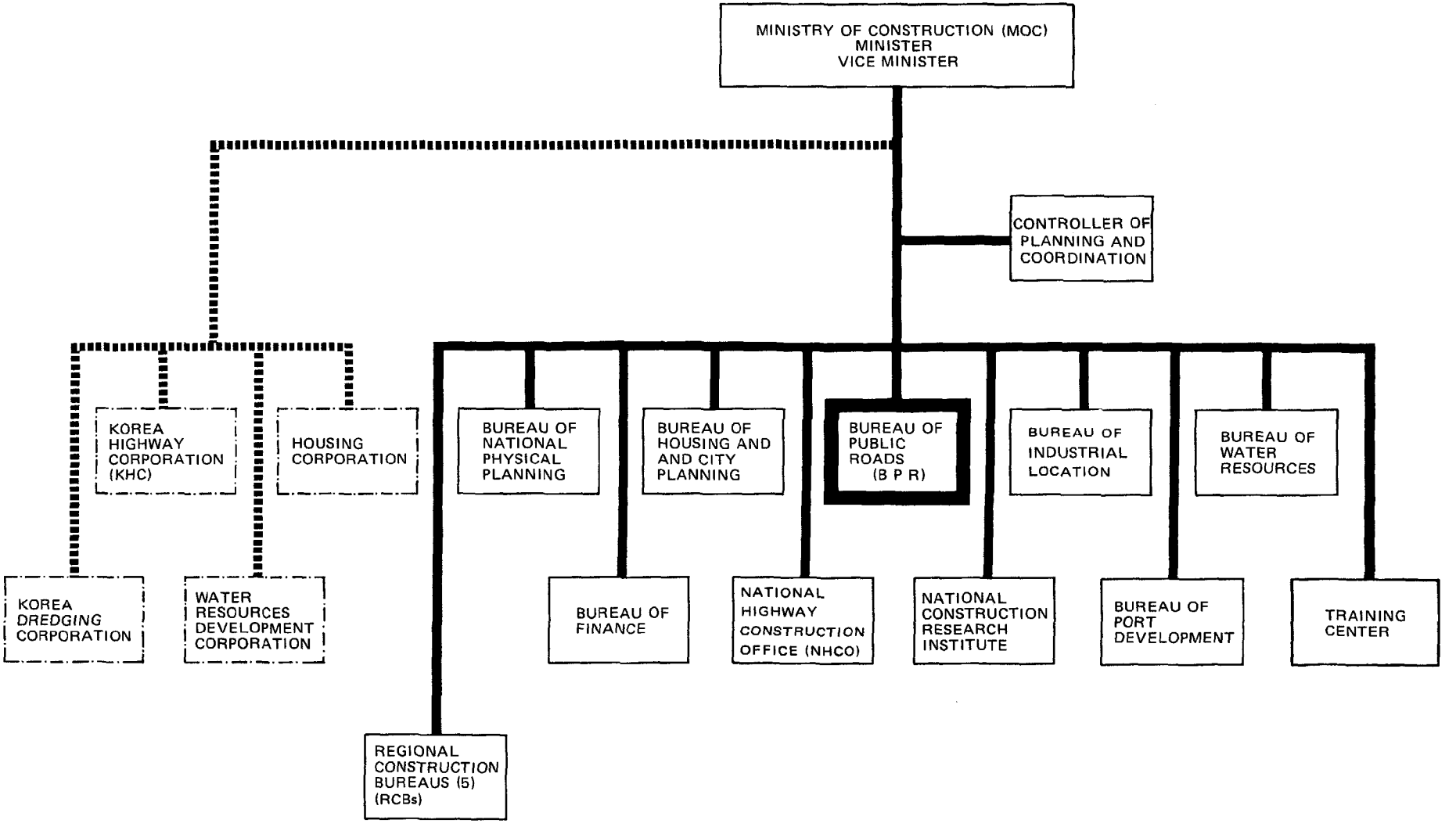
2/ Assumes costs 15% higher and benefits 25% lower than in the best estimate, excepted for the maintenance program where figures are reduced to 10% and 20% respectively.

Sources: Mission's Estimates

August, 1973

KOREA: SECOND HIGHWAY PROJECT

MINISTRY OF CONSTRUCTION ORGANIZATION

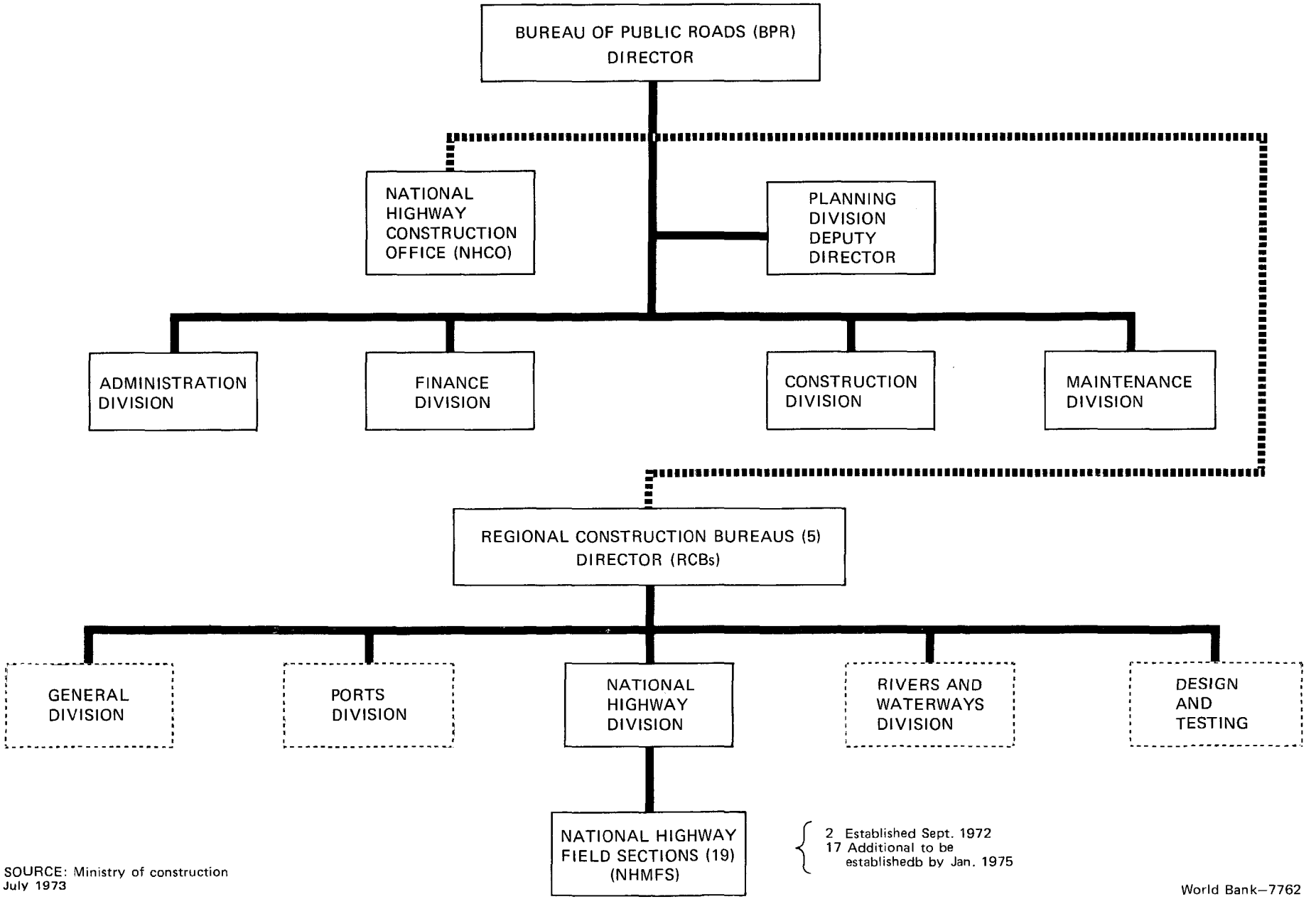


SOURCE: Ministry of Construction

July 1973

World Bank–7761

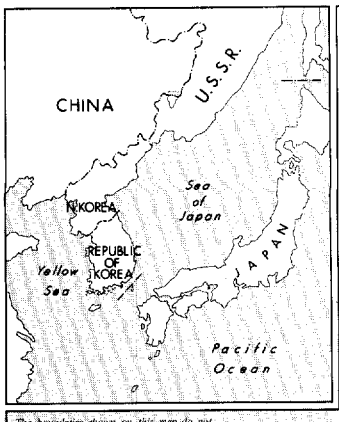
KOREA: SECOND HIGHWAY PROJECT
BUREAU OF PUBLIC ROADS ORGANIZATION



SOURCE: Ministry of construction
July 1973

World Bank—7762

IBRD 10588
JULY 1973



The boundaries shown on this map do not imply endorsement or acceptance by the World Bank and its affiliates.

NORTH KOREA

Cheolwon
Geumhwa
Sokcho
Whacheon
Yanggu
Yangyang
Imjin River
Jumunjin
Munsan
Chuncheon
Gyeongpodae
Gangreung
Gangwha
Euijeongbu
Hongcheon
N. Han River
Donong
Samwha
Mukho
SEOUL
Hoengseong
Yeoryong
Incheon
Yangpyeong
Samcheok
Saemal
S. Han River
Weonju
Icheon
Yeoju
Jangseong
Suwon
Jupo
Jecheon
Hayeong
Maepo
Uljin
Pyongtaek
Anseong
Chungju
Danyang
Yeongju
Manripo
Onyang
Cheonan
Yesan
Hongsong
Eunseong
Andong
Jochiweon
Cheongju
Jeomchon
Jinbo
Gongju
Boeun
Yeongdeog
Sangju
Nakdong River
Buyeo
Daejeon
Nonsan River
Nonsan
Yeonmudae
Gimcheon
Porang
Geum River
Janghang
Yeoncheon
Gunsan
Iri
Daegu
Gyeongju
Kampo
Jeonju
Gimje
Gochang
Ulsan
Changnyeong
Nakdong River
Beobseongpo
Namweon
Damyang
Yeongwang
Yeongwha
Masan
Gimhae
Jinju
Pochon
Jinhae
Gwangju
BUSAN
Hwasun
Naju
Samcheonpo
Yeongsanpo
Suncheon
Yongsan River
Jinsenpo
Chungmu
Beolgyo
Mokpo
Yeosu
Mijo
Seongjeon
Gangjin
Goheung
Singeum
Wando
Jeju
Seogipo

KOREA
NATIONAL HIGHWAY NETWORK

EXISTING NATIONAL HIGHWAYS
- EXPRESSWAY (FOUR LANE TOLL)
- NATIONAL HIGHWAYS (PAVED)
- NATIONAL HIGHWAYS (UNPAVED)

PROJECT HIGHWAYS
- FEASIBILITY STUDY AND ENGINEERING — TECHNICAL ASSISTANCE CR 54-KO; FIRST PROJECT LOAN 769-KO
- CONSTRUCTION AND IMPROVEMENT — FIRST PROJECT LOAN 769-KO
- CONSTRUCTION AND IMPROVEMENT — SECOND PROJECT
- PAVING — SECOND PROJECT

- RAILWAYS
- AIRPORTS (INTERNATIONAL)
- PROVINCIAL CAPITALS
- INTERNATIONAL BOUNDARIES

0 20 40 60 80 100
KILOMETERS